MANITOBA AMBIENT AIR QUALITY
ANNUAL REPORT - 1987

Manitoba
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ANNUAL REPORT - 1987

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ABSTRACT

As part of an on-going environmental quality monitoring program, the Manitoba Department of Environment monitored the quality of ambient air at several urban locations during 1987. This monitoring consisted of the use of established monitoring sites having dedicated instrumentation for continuous air sampling and analysis.

The ambient air quality program is structured to determine air quality in two areas: general urban air quality and air quality in the vicinity of specific industries.

The general urban air quality program consisted primarily of sampling activities within the Federal/Provincial National Air Pollution Surveillance (NAPS) program. Sampling at NAPS sites consisted of measurement of the common air pollutants including carbon monoxide, nitrogen dioxide, nitric oxide, ozone, sulphur dioxide, total suspended particulate matter, inhalable particulate, soiling index, lead, sulphates, and nitrates. Of these contaminants, total suspended particulate matter and ozone most often exceeded the Provincial Air Quality Objectives. Based on the proposed amended Canadian Annual Index of Air Quality, the air quality in the downtown and residential areas of Winnipeg was rated as "Good" most of the time.

The monitoring of air quality in the vicinity of specific industries having (or potentially having) atmospheric emissions was restricted to the areas around the Northern smelters (at Flin Flon and Thompson), the pulp and paper mill at The Pas, and an ammonia fertilizer manufacturer in Brandon. Monitoring was specifically for the pollutant of industrial emission. Data from the above locations showed that, on occasion, levels above air quality objectives and/or guidelines were measured. Monitoring at Northern locations ceased in April 1987.

TABLE OF CONTENTS

	PAGE
ABSTRACT	
TABLE OF CONTENTS	i
LIST OF TABLES AND FIGURES	ii
INTRODUCTION	1
BACKGROUND	
A) Manitoba Air Quality Objectives and Guidelines	3
B) Pollutants	8
C) Sampling Sites	15
D) Index of the Quality of Air	22
RESULTS	24
DISCUSSION	
A) Winnipeg Air Quality	31
B) Brandon Air Quality	38
C) The Pas Air Quality	40
D) Flin Flon Air Quality	40
E) Thompson Air Quality	41
BIBLIOGRAPHY	42
APPENDIX	43

LIST OF TABLES AND FIGURES

TABLES		PAGE
TABLE 1	Objectives and Guidelines for Various Air Pollutants (Ambient Air Criteria).....	4
TABLE 2	Ambient Air Monitoring Sites (1987).....	15
TABLE 3-6	Manitoba Ambient Air Quality Data 1987.....	27

FIGURES		
FIGURE 1	Manitoba Ambient Air Quality Monitoring Network....	16
FIGURE 2	Winnipeg Ambient Air Monitoring Stations.....	17
FIGURE 3	Brandon Ambient Air Monitoring Stations.....	18
FIGURE 4	The Pas Ambient Air Monitoring Station.....	19
FIGURE 5	Flin Flon Ambient Air Monitoring Stations.....	20
FIGURE 6	Thompson Ambient Air Monitoring Station.....	21
FIGURE 7	Carbon Monoxide Levels, Winnipeg, Scotia & Jefferson.....	Appendix
FIGURE 8	Carbon Monoxide Levels, Winnipeg, 65 Ellen Street..	
FIGURE 9	Nitrogen Dioxide Levels; Winnipeg, Scotia & Jefferson.....	
FIGURE 10	Nitrogen Dioxide Levels; Winnipeg, 65 Ellen Street.	
FIGURE 11	Nitrogen Dioxide Levels; Brandon, Assiniboine Community College.....	
FIGURE 12	Ozone Levels; Winnipeg, Scotia & Jefferson.....	
FIGURE 13	Ozone Levels; Winnipeg, 65 Ellen Street.....	
FIGURE 14	Ozone Levels; Brandon, Assiniboine Community College.....	
FIGURE 15	Soiling Index Levels; Winnipeg, Scotia & Jefferson.	
FIGURE 16	Soiling Index Levels; Winnipeg. 65 Ellen Street....	
FIGURE 17	Ammonia Levels; Brandon, Assiniboine Community College.....	
FIGURE 18	Ammonia Exceedences; Brandon, Assiniboine Community College.....	
FIGURE 19	Sulphur Dioxide; Flin Flon, Downtown.....	
FIGURE 20	Sulphur Dioxide; Flin Flon, Channing.....	
FIGURE 21	Sulphur Dioxide; Thompson, 59 Elizabeth Road.....	
FIGURE 22	Hydrogen Sulphide Levels; The Pas.....	

LIST OF TABLES AND FIGURES (cont'd)

FIGURES		PAGE
FIGURE 23	Total Suspended Particulate, Winnipeg, Scotia & Jefferson.....	Appendix
FIGURE 24	Total Suspended Particulate, Winnipeg, 65 Ellen Street.....	
FIGURE 25	Total Suspended Particulate, Winnipeg, 2120 Portage Avenue.....	
FIGURE 26	Total Suspended Particulate, St. Francois-Xavier.....	
FIGURE 27	Total Suspended Particulate, Brandon, 1104 Princess Avenue.....	
FIGURE 28	Total Suspended Particulate, Brandon, Assiniboine Community College	
FIGURE 29	Inhalable Particulate, Winnipeg, 65 Ellen Street	
FIGURE 30	Lead, Winnipeg, Scotia & Jefferson.....	
FIGURE 31	Lead, Winnipeg, 65 Ellen Street.....	
FIGURE 32	Lead, Winnipeg, 2120 Portage Avenue.....	
FIGURE 33	Lead, St. Francois-Xavier.....	
FIGURE 34	Lead, Brandon, 1104 Princess Avenue.....	
FIGURE 35	Lead, Brandon, Assiniboine Community College	
FIGURE 36	Sulphates, Winnipeg, Scotia & Jefferson.....	
FIGURE 37	Sulphates, Winnipeg, 65 Ellen Street.....	
FIGURE 38	Sulphates, Winnipeg, 2120 Portage Avenue.....	
FIGURE 39	Sulphates, St. Francois-Xavier.....	
FIGURE 40	Sulphates, Brandon, 1104 Princess Avenue.....	
FIGURE 41	Sulphates, Brandon, Assiniboine Community College.....	
FIGURE 42	Nitrates, Winnipeg, Scotia & Jefferson.....	
FIGURE 43	Nitrates, Winnipeg, 65 Ellen Street.....	
FIGURE 44	Nitrates, Winnipeg, 2120 Portage Avenue.....	
FIGURE 45	Nitrates, St. Francois-Xavier.....	
FIGURE 46	Nitrates, Brandon, 1104 Princess Avenue.....	
FIGURE 47	Nitrates, Brandon, Assiniboine Community College	
FIGURE 48	Index of the Quality of Air, Winnipeg, Downtown	
FIGURE 49	Index of the Quality of Air, Winnipeg, Residential	

INTRODUCTION

The Air Quality Section of Manitoba Environment has been monitoring ambient air at several locations throughout Manitoba since 1968. Monitoring activities in 1987 took place in Winnipeg, Brandon, Thompson, Flin Flon and The Pas.

The majority of sampling is of a continuous nature involving dedicated monitors in permanent stations and can be divided into two basic categories; (1) General or Urban Air Quality monitoring and (2) Source specific or Industrial monitoring. Much of the General or Urban Air Quality monitoring is performed under the auspices of the Federal-Provincial National Air Pollution Surveillance (NAPS) program, which provides a nationwide data base for determining the extent of air pollution in Canada, and also documents trends arising as a result of changing industrial activity, fuel use, population density and use of pollution control strategies.

Source specific or Industrial monitoring is performed by the Impingement Program within the Air Quality Section. This monitoring contributes to the evaluation of ambient air quality in the vicinity of specific industries in order to determine compliance with Provincial Air Quality Guidelines and Objectives.

This report covers the 1987 data for the following parameters: Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Nitric Oxide (NO), Nitrogen Oxides (NO_x), Ozone (O_3), Ammonia (NH_3), Hydrogen Sulphide (H_2S), Sulphur Dioxide (SO_2), Soiling Index (COH), Total Suspended Particulate (TSP), Inhalable Particulate (IP), Lead (Pb), Sulphates (SO_4), and Nitrates (NO_3).

The objectives of this report are; (1) to outline ambient air monitoring activities in the Province during 1987, (2) to provide summary statistics and a comparison to air quality objectives and/or guidelines (where applicable), (3) to compare 1987 data with previous years and (4) to provide a rating of the air quality relative to the proposed amended Canadian Annual Index of Air Quality.

BACKGROUND

A) Manitoba Air Quality Objectives and Guidelines

The Province of Manitoba has adopted the National Ambient Air Quality objectives for those pollutants for which such objectives have been promulgated (sulphur dioxide, suspended particulate matter, carbon monoxide, ozone and nitrogen dioxide). Air Quality Guidelines have been developed and adopted internally for the remaining pollutants.

The above criteria have been designed about three levels:

Maximum Tolerable Level (MTL) - these criteria pollutant levels are those which, due to a diminishing margin of safety, appropriate action is required to protect the health of the general population.

Maximum Acceptable Level (MAL) - these criteria pollutant levels are intended to provide adequate protection against effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well being.

Maximum Desirable Level (MDL) - these criteria pollutant levels define long term goals for air quality and provide a basis for an antidegradation policy for the unpolluted part of the country and for the continuing development of control technology.

In the majority of cases, urban air quality is expected to meet the MAL, whereas, in rural areas, it is the long term goal to ensure that the MDL's are not exceeded.

A list of "Ambient Air Criteria" currently endorsed by Manitoba Environment is presented in Table 1.

TABLE 1

OBJECTIVES AND GUIDELINES FOR VARIOUS AIR POLLUTANTS

AMBIENT AIR CRITERIA

The following schedule lists maximum time-based pollutant concentration levels for the protection and preservation of ambient air quality within the Province of Manitoba. Each contaminant is classified either as objective or guideline status depending upon several factors. The objective classification is directed toward those air pollutants sufficiently widespread in presence and of potential environmental effect that formulation of limits has been thorough and well documented. The guideline classification is used for those pollutants of a more localized presence and for which a lesser degree of documentation in support of the chosen criteria is available.

For the air contaminants mentioned in Column 1, the amount thereof in the outside air measured in the units set out in Columm 2 during the period of time set out in Column 3, shall not be in greater concentration than the amount shown in:

- Column 4 representing the MAXIMUM TOLERABLE LEVEL which denotes a time - based concentration of air contaminant beyond which, due to a diminishing margin of safety, appropriate action is required to protect the health of the general population.
- Column 5 representing the MAXIMUM ACCEPTABLE LEVEL which is deemed essential to provide adequate protection for soils, water, vegetation, materials, animals, visibility, personal comfort and well-being.
- Column 6 represents the MAXIMUM DESIRABLE LEVEL which defines the long term goal for air quality and provides a basis for an anti-degradation policy for the unpolluted parts of Manitoba and for the continuing development of control technology.

This schedule is intended to serve as a guide for the evaluation of air quality and for planning purposes. The selection of the appropriate concentration category will depend upon the degree of protection to be afforded to effected receptors. Maximum Tolerable Levels are only for evaluation purposes to identify the severity of an anthropogenic or natural phenomenon in order to protect human health and institute appropriate corrective action. In general, Maximum Acceptable Levels are not to be exceeded in any urban centre including areas that are in the vicinity of industries with atmospheric emissions. Within rural areas, it is the goal to maintain pollutant concentrations at or below Maximum Desirable Levels.

COLUMN 1		COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
Name of Contaminant	Contaminant Classification	Units of Concentration Measurement	Period of Time Contaminant is Measured	Maximum Tolerable Level Concentration	Maximum Acceptable Level Concentration	Maximum Desirable Level Concentration
Ammonia	Guideline	milligrams per cubic metre (parts per million) of air	1-hour average		1.4 (2.0)	
Carbon Monoxide	Objective	milligrams per cubic metre (parts per million) of air	1-hour average		35 (30)	15 (13)
			8-hour average	20 (17)	15 (13)	6 (5)
Chromic Acid (as Cr^{+6})	Guideline	micrograms per cubic metre of air	1-hour average		4.5	
Dustfall in Excess of Normal Background Levels	Guideline	milligrams per square centimetre (tons per square mile per month)	air basin average 30 days		0.8 (22.8)	0.6 (17.1)
			single point 30 days		1.5 (42.8)	1.1 (31.4)
Fluorides (as Fluoridation)	Guideline	micrograms per 100 square centimetres	30 days		40	
Fluorides (as HF)	Guideline	micrograms per cubic metre (parts per billion) of air	24-hr. average		0.85 (1.06)	0.40 (0.50)
			7 day average		0.55 (0.69)	0.22 (0.28)
			30 day average		0.35 (0.44)	
			70 day average		0.20 (0.25)	
Hydrogen Chloride	Guideline	micrograms per cubic metre (parts per million) of air	1-hr. average		100 (.07)	
Hydrogen Sulphide	Guideline	micrograms per cubic metre (parts per billion) of air	1-hour average	1400 (1000)	15 (11.0)	1 (0.7)
			24-hr. average		5 (4.0)	

COLUMN 1		COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
Name of Contaminant	Contaminant Classification	Units of Concentration Measurement	Period of Time Contaminant is Measured	Maximum Tolerable Level Concentration	Maximum Acceptable Level Concentration	Maximum Desirable Level Concentration
Lead	Guideline	micrograms per cubic metre of air	24-hr. average		5.0	
Nitrogen Dioxide	Objective	micrograms per cubic metre (parts per million) of air	1-hour average	1000 (.53)	400 (0.213)	
			24-hr. average		200 (0.106)	
			Annual arithmetic mean		100 (0.053)	60 (0.032)
Odours	Guideline	odour units	two tests not less than 15 minutes apart nor more than 60 minutes apart		Residential Zone 2.0 (one volume of odorous air diluted with one volume of odour free air) Industrial Zone 7.0 (one volume of odorous air diluted with six volumes of odour free air)	<1.0 (less than the odour threshold)
					Also see note on next page	
Oxidants (Ozone)	Objective	micrograms per cubic metre (parts per million) of air	1-hour average	400 (.20)	164 (0.082)	100 (0.05)
			24-hr. average		50 (0.025)	30 (0.015)
			Annual arithmetic mean		30 (0.015)	
Soiling Index	Guideline	coefficient of haze per 1000 feet of air	24-hr. average		1.0	0.45
			Annual arithmetic mean		0.45	0.3

COLUMN 1		COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
Name of Contaminant	Contaminant Classification	Units of Concentration Measurement	Period of Time Contaminant is Measured	Maximum Tolerable Level Concentration	Maximum Acceptable Level Concentration	Maximum Desirable Level Concentration
Sulphation	Guideline	milligrams of sulphur trioxide per 100 square centimetres per day	30 days		1.0	0.4
Sulphur Dioxide	Objective	micrograms per cubic metre (parts per million) of air	1-hour average		900 (0.34)	450 (0.17)
			24-hr. average	800 (.31)	300 (0.11)	150 (0.06)
			Annual arithmetic mean		60 (0.02)	30 (0.01)
Sulphuric Acid Mist	Guideline	micrograms per cubic metre (parts per million) of air	1-hr. average		100 (.025)	
Suspended Particulate Matter	Objective	micrograms per cubic metre of air	24-hr. average	400	120	
			Annual geometric mean		70	60

Note: Odours:
The release of offensive odours past the property line of any source shall be eliminated, or minimized, such that the said odours will not interfere with the comfort, well-being or enjoyment of any person. In most situations, achieving the Maximum Acceptable Level, will satisfy this condition.

All measurements of air quality are corrected to a reference temperature of 25°C and to a reference pressure of 101.3 kilopascals.

Revised

July, 1985

B) POLLUTANTS

Pollutants monitored in the Manitoba Ambient Air Quality Network included:

Carbon Monoxide

Carbon monoxide (CO) is a colourless, odourless and tasteless gas slightly lighter than air. It is considered a dangerous asphyxiant because it combines strongly with the hemoglobin of the blood and reduces the blood's ability to carry oxygen to cell tissues. CO is a product of incomplete combustion of carbon and is emitted by fossil fuel combustion sources (i.e. motor vehicle). CO is measured on a continuous basis by the technique of non-dispersive infrared spectrometry and the data is generally reported in the unit form of hourly averages from which further time-weighting can be determined.

Nitrogen Dioxide

Nitrogen dioxide (NO_2) is a reddish-brown gas with a pungent, irritating odour. It originates chiefly from combustion sources as well as from conversion of nitric oxide. Nitrogen dioxide exerts its primary toxic effect on the lungs and can be associated with increased susceptibility to respiratory infections and emphysematous changes. Nitrogen dioxide also suppresses vegetation growth, causes corrosion of metals, reduces visibility and acts as a precursor with reactive hydrocarbons for oxidant formation. It is measured continuously by the technique of chemiluminescence with unit data reported as hourly averages.

Nitrogen dioxide is also recognized as a significant contributor to the formation of acid rain.

Nitric Oxide

Nitric oxide (NO) is a colourless, odourless and tasteless gas which in nature is produced by biological action but in polluted atmospheres is produced primarily by fuel combustion in both stationary and mobile sources. By itself nitric oxide is not usually considered a pollutant but in a polluted atmosphere, it is readily oxidized to nitrogen dioxide through photochemical secondary reaction. Nitric oxide is measured concurrently with nitrogen dioxide by the technique of chemiluminescence and the data is processed as hourly averages.

Ozone

Ozone (O_3) is a pungent irritating gas formed at high altitudes by photochemical reaction involving molecular and atomic oxygen. Ozone and other oxidants are formed in polluted atmospheres as a result of a rather wide variety of photochemical reactions involving nitrogen oxides and reactive hydrocarbons. The overall effect of ozone is a stinging of the eyes and the mucous membranes. It is also responsible for an increase in asthma effects and respiratory restriction. Ozone reduces vegetation yields, injures vegetation and weakens materials such as rubber and certain fabrics, and is the major contributor to the formation of smog. Ozone is measured by use of the chemiluminescence technique and unit data reported as hourly averages.

Ammonia

Ammonia (NH_3) is a colourless gaseous alkaline compound of nitrogen and hydrogen. It is lighter than air, of extremely pungent smell and taste, and very soluble in water, and can be easily condensed by cold and pressure to

a liquid. Ammonia is an important industrial and agricultural compound as well as a nuisance, but it is not a major pollutant of the environment. It is used both free and combined in medicine, the arts and industry. Ammonia is measured continuously by the technique of chemiluminescence with unit data reported as hourly averages.

Hydrogen Sulphide

Hydrogen sulphide (H_2S) is a toxic, foul smelling gas well-known for the rotten egg-like odour at a very low concentration. Hydrogen sulphide as an occasional air contaminant is almost always associated with some specific incident or industrial process. The concentration of hydrogen sulphide in the ambient air is rarely high enough to harm either vegetation or man. However, at high concentrations, it will produce loss of sense of smell, severe respiratory tract irritation and material damage such as the staining of lead based paints. H_2S is measured continuosly by the technique of pulsed fluorescence. Unit data is reported as hourly averages.

Sulphur Dioxide

Sulphur dioxide (SO_2) is a colourless gas with a pungent irritating odour emitted primarily from the combustion of fossil fuels containing sulphur, and from primary non-ferrous smelting. It is usually recognized as one of the major atmospheric pollutants. Sulphur dioxide produces an increased frequency of respiratory disease symptoms and lung disease. It also produces marked effects on vegetation, corrodes materials and may oxidize in the atmosphere to form sulphuric acid and sulphates. Sulphur dioxide is the major contributor to the formation of acid rain.

Sulphur dioxide is measured by use of the pulsed fluorescence

technique. Unit data is reported as hourly averages.

Soiling Index (Smoke)

Soiling index (COH) is an indication of the soiling or darkening potential of fine particulate in the atmosphere usually resulting from combustion. These particles are usually in the size range of 0.1 to 1 micron in diameter. A tape sampler is used to collect the "smoke" particles on a filter paper and the degree of light transmission on an hourly basis is reported as Coefficient of Haze (COH) units.

Total Suspended Particulate

Total Suspended Particulate (TSP) is a general term which applies to a large variety of solid or liquid particles of a size and configuration such that they remain suspended in the air and can be drawn into the respiratory passages. These types of particles usually in the size range of 0.1 to 100 microns may originate as a result of industrial processes, human activities and from natural sources such as wind swept or entrained dust. By itself, or in association with other pollutants, TSP, in enough concentration, may injure the respiratory system. TSP also may reduce visibility and contribute to property damage and soiling. A high volume air sampler is used to collect the particles on a glass fibre filter and results are reported as integrated 24-hour concentration of mass of particulate matter per volume of air.

Inhalable Particulate

Inhalable particulate (IP) is a fraction of the total suspended particulate found in the air. It is defined as the range of particles (solid and liquid) between 0.1 and 10 um in diameter (PM_{10}) that can penetrate into

the tracheobronchial and alveolar regions of the lungs. A dichotomous sampler was used to collect the sample; a fine fraction less than 2.5 um, and a course fraction between 2.5 and 10 um. These two particulate sizes are combined to give the total for the inhalable particulate in a 24-hour period.

Lead

Lead (Pb) exists in the atmosphere primarily as a particulate resulting from the combustion of leaded gasoline and from certain source industries. Exposure to lead will adversely affect human health (especially young children) by absorption into the bloodstream and impairment of heme synthesis in cells. Other adverse effects associated with elevated blood lead levels include the possibility that nervous system damage may occur. Lead is analyzed from a representative portion of the total suspended particulate collected by high volume sampling. Air concentrations are reported as integrated 24-hour concentrations of mass of lead per volume of air.

Sulphates

Sulphates (SO_4) in the atmosphere are primarily in the form of aerosols such as sulphuric acid and in particulates such as compounds of ammonium and zinc sulphates. Particulate sulphates can arise as a result of hydrogen sulphide oxidation, but are primarily formed from the oxidation of sulphur dioxide. Sulphates can impact on health as small particulate which enter the respiratory system and have been associated as a major contributing factor to visibility reduction. Sulphates are measured as a constituent of total suspended particulate and reported as integrated 24-hour concentrations of mass of sulphate per volume of air.

Nitrates

Nitrates (NO_3) in the atmosphere can be in the form of aerosols, gases, and particulate. The nitrate ion is the most oxidized form of nitrogen and the nitrate salts of all common metals are quite water soluble. Particulate nitrate are believed to contribute to atmospheric haze. Particulate nitrate (and sulphates) may be a major part of dry atmospheric acidic deposition. Nitrate levels are particulate nitrate determined as a constituent of total suspended particulate and are reported as integrated 24-hour concentrations of mass of nitrate per volume of air.

C) SAMPLING SITES

Figure 1 is a map of the urban areas included in the Manitoba Ambient Air Quality Monitoring Network. Figures 2 through 6 depict the monitoring locations within each of the urban centres.

Air monitoring stations are listed in a more detailed form in Table 2 as to location, code number, pollutants monitored, and period during 1987 that monitoring took place.

TABLE 2

AMBIENT AIR MONITORING SITES (1987)

AREA	CODE	SAMPLING SITE LOCATION	SAMPLE PERIOD	POLLUTANTS MONITORED
Winnipeg (Downtown) NAPS station	9119	65 Ellen Street	Jan. - Dec.	SO_2, CO, NO_2, NO, NO_x, O_3, TSP, IP, Pb, SO_4, NO_3, COH
Winnipeg (Residential) NAPS station	9118	299 Scotia Street	Jan. - Dec.	SO_2, CO, NO_2, NO, NO_x, O_3, COH, TSP, Pb, SO_4, NO_3
Winnipeg (Roadside) NAPS station	9102	2120 Portage Avenue	Jan. - Dec.	TSP, Pb, SO_4, NO_3
St. Francois Xavier (Wpg. Background)	4304	MTS Trailer	Jan. - Dec.	TSP, Pb, SO_4, NO_3
Brandon (Downtown) NAPS station	9201	11th St. & Princess	Jan. - Dec.	TSP, Pb, SO_4, NO_3
Brandon (Industrial)	5131	Assiniboine Community College (Lot)	Jan. - Dec. Sept. - Dec.	NH_3, NO_2, NO, NO_x SO_2, O_3, TSP, Pb SO_4, NO_3
The Pas	7111	3rd & Ross (Provincial Building)	Jan. - Mar.	H_2S (TRS)
Flin Flon	7233	35 Main Street	Jan. - Mar.	SO_2
	7222	Channing Drive	Jan. - Mar.	SO_2
Thompson	7344	59 Elizabeth Drive	Jan. - Mar.	SO_2

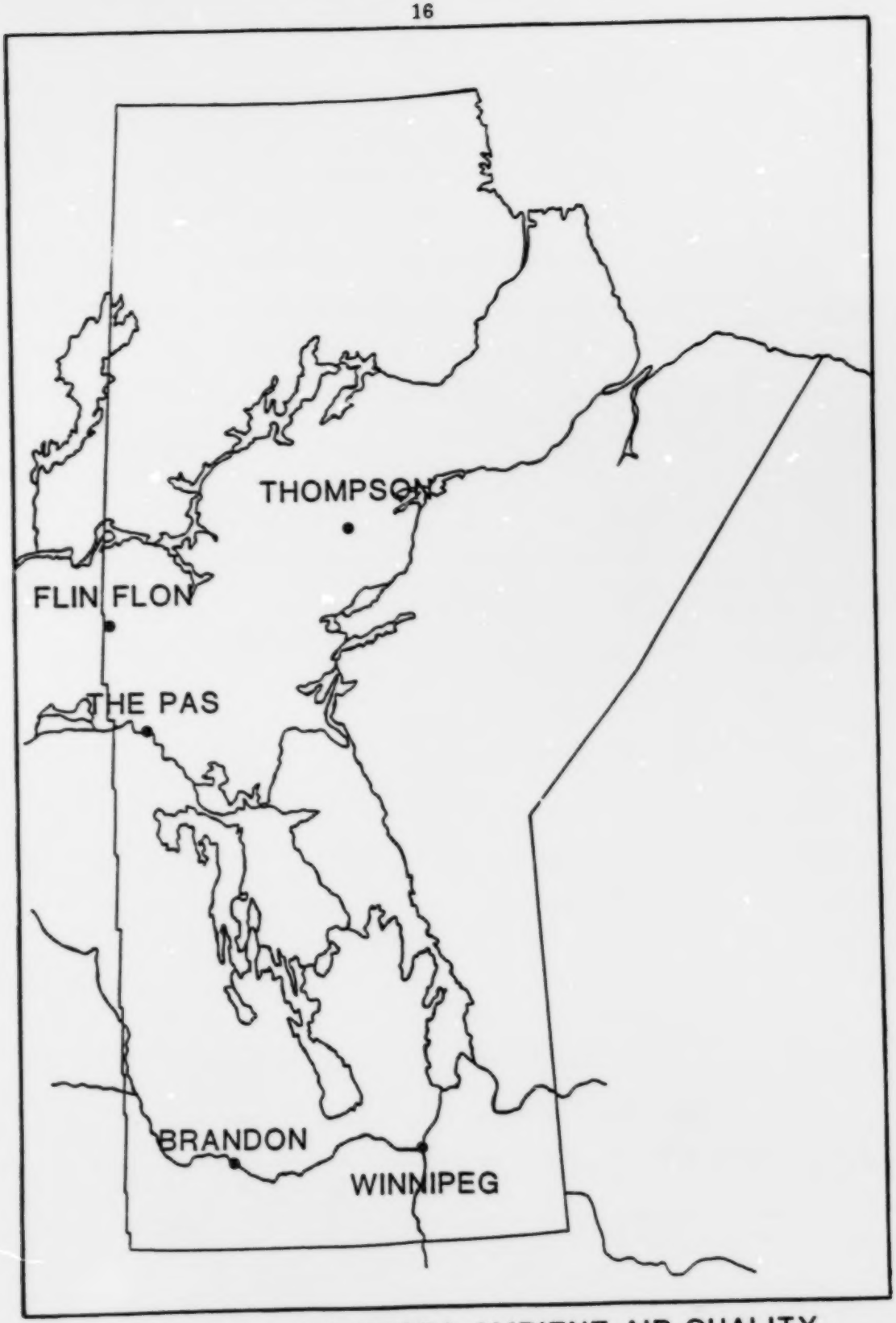

Figure 1 MANITOBA AMBIENT AIR QUALITY MONITORING NETWORK

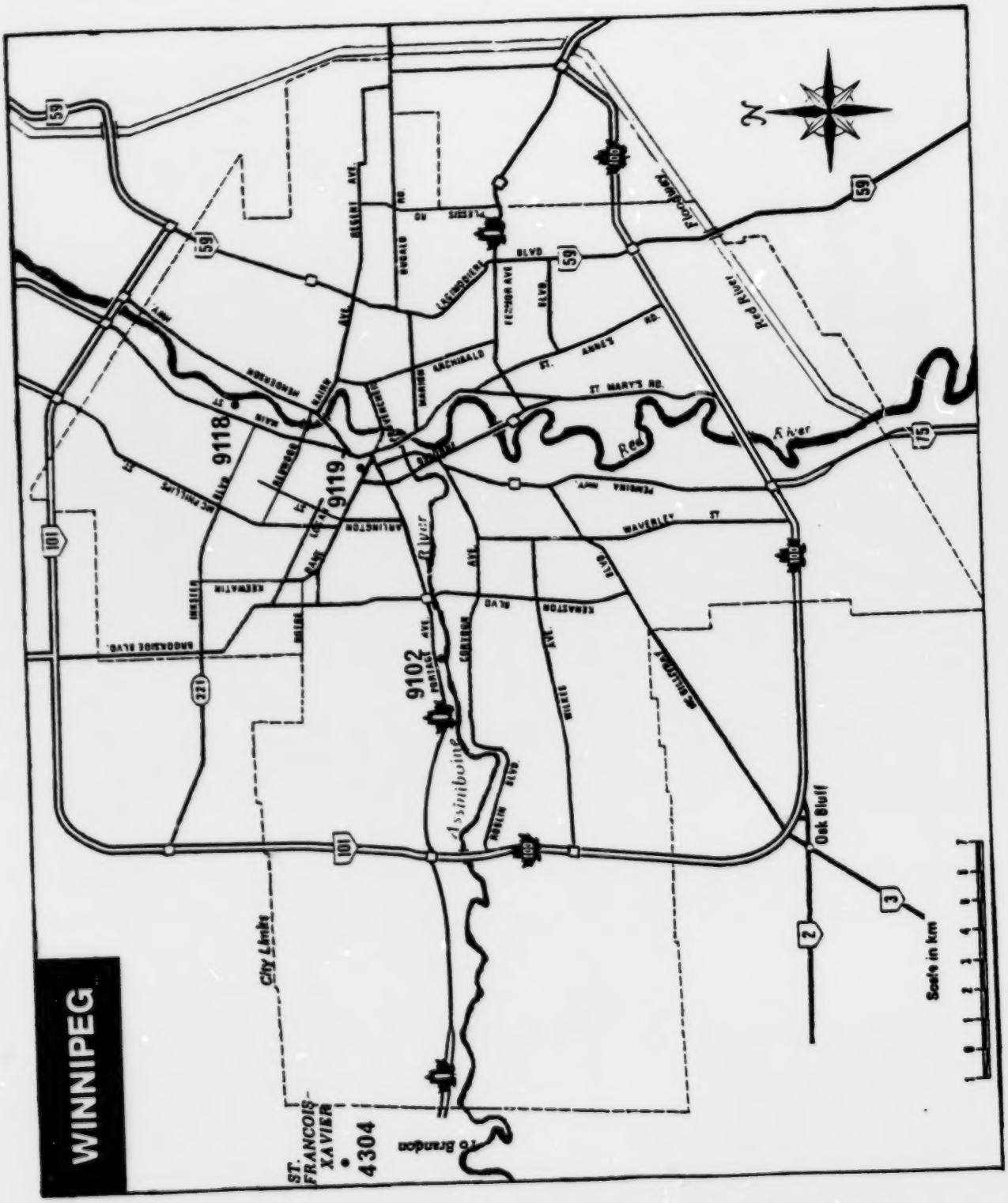

Figure 2 WINNIPEG AMBIENT AIR MONITORING STATIONS

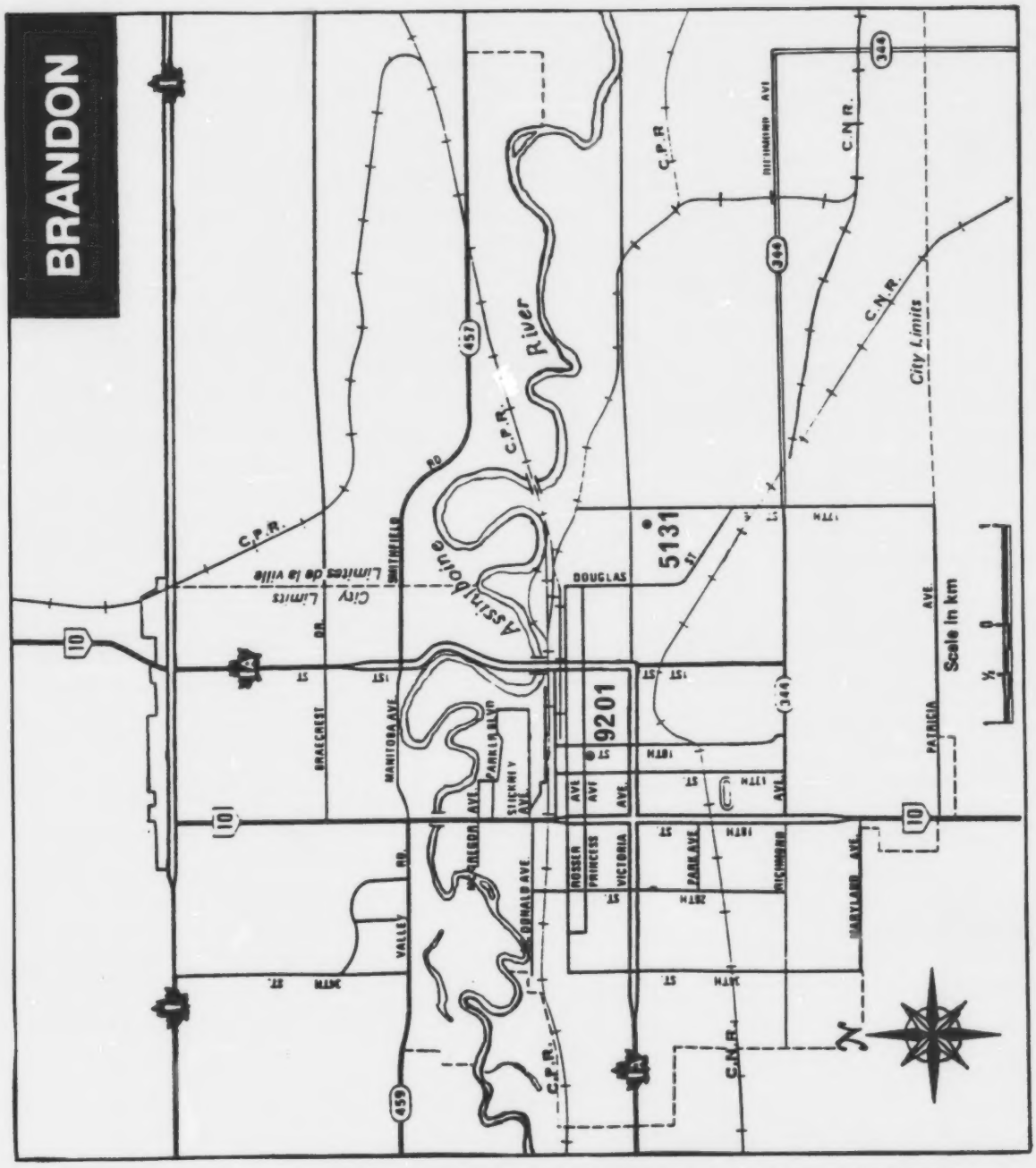

Figure 3 BRANDON AMBIENT AIR MONITORING STATIONS

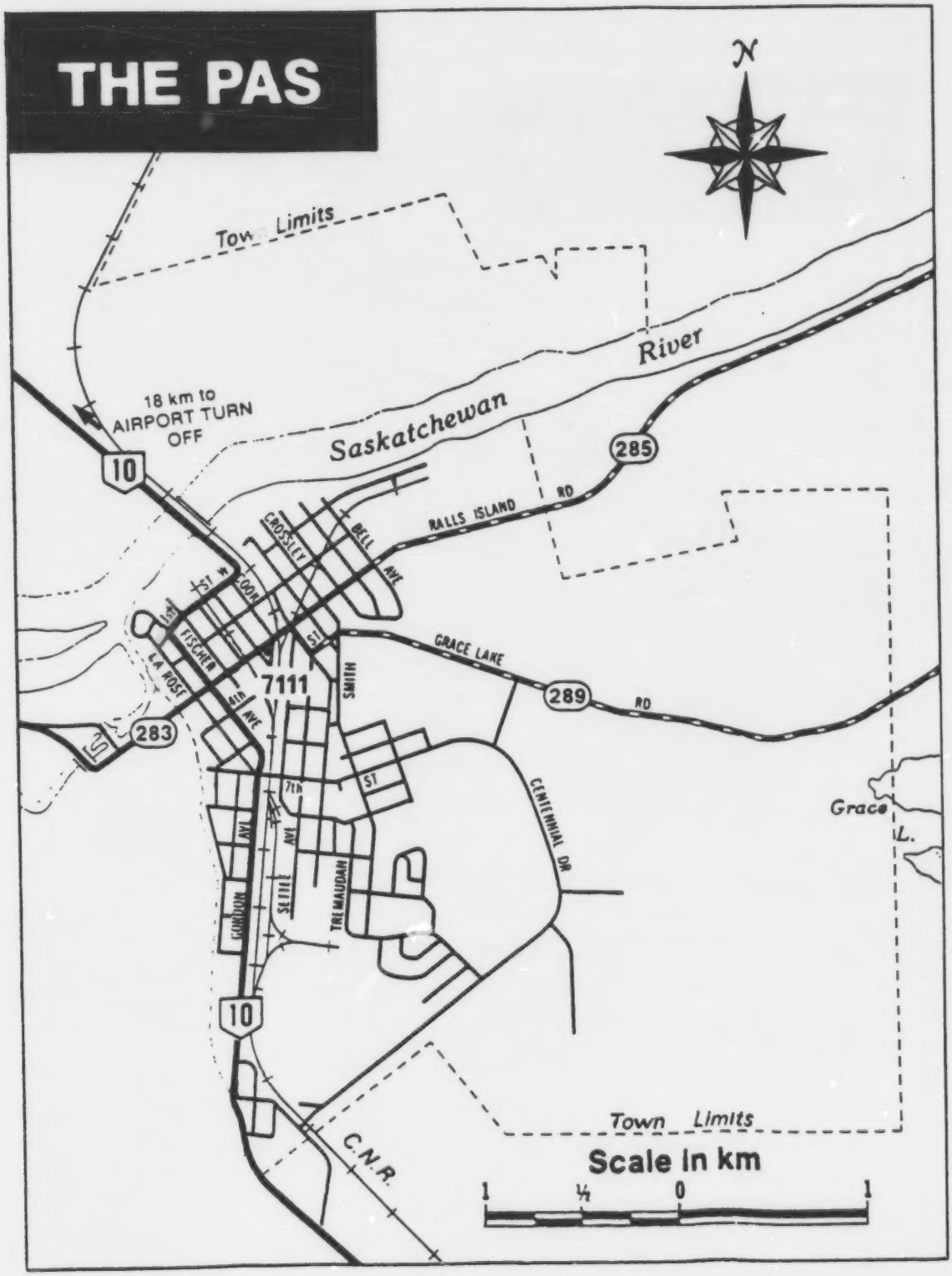

Figure 4 THE PAS AMBIENT AIR MONITORING STATION

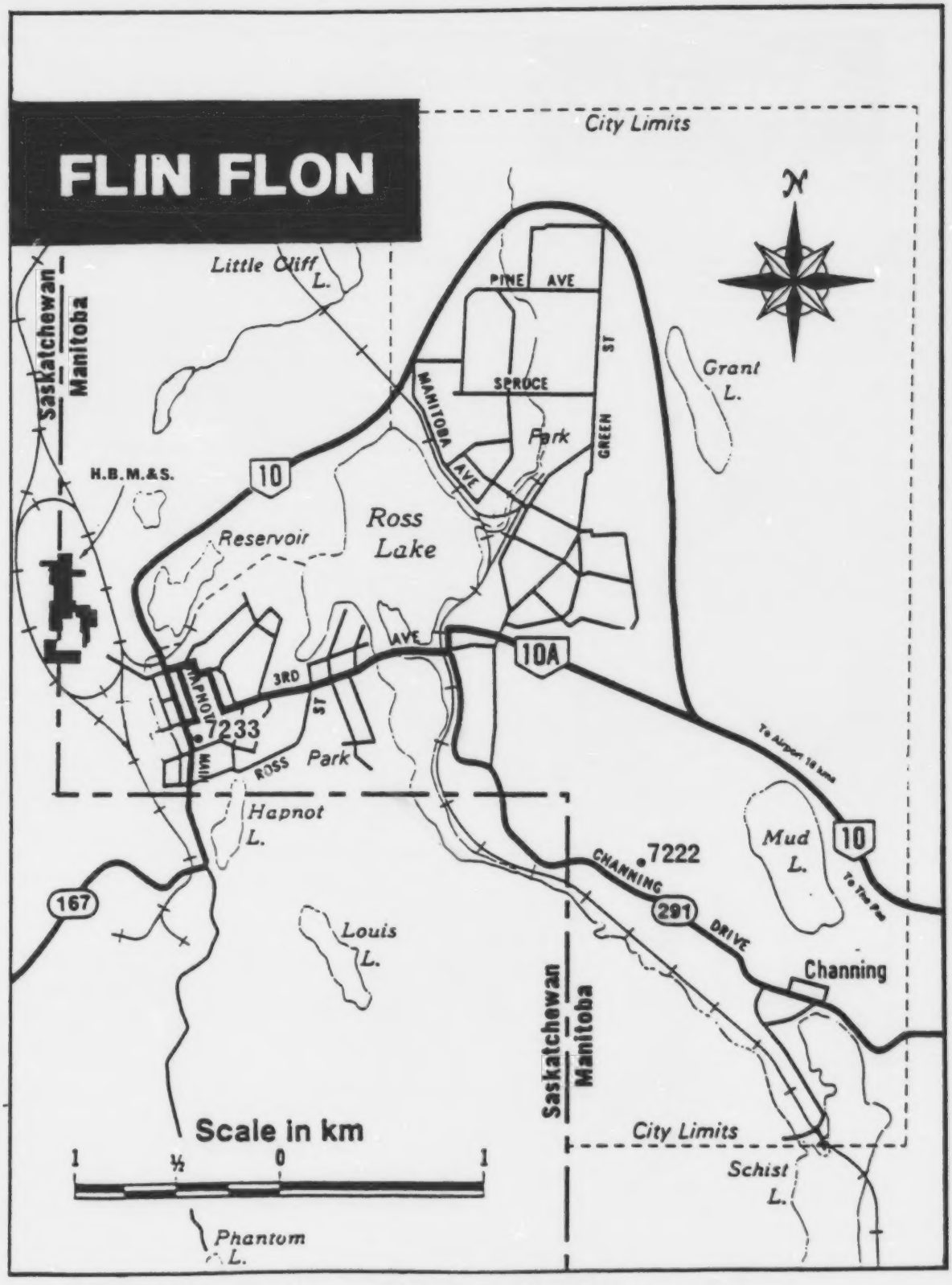

Figure 5 FLIN FLON AMBIENT AIR MONITORING STATIONS

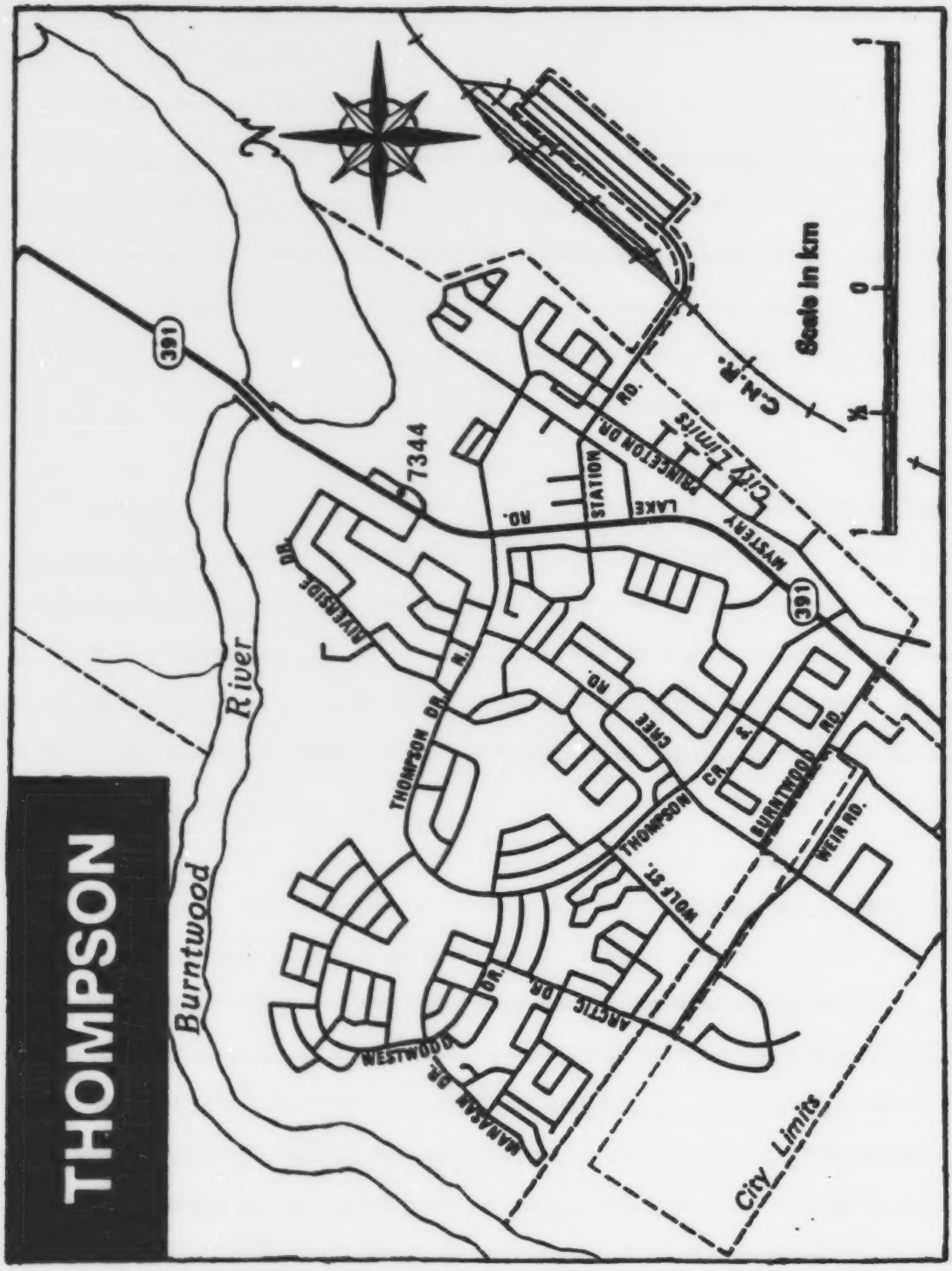

Figure 6 THOMPSON AMBIENT AIR MONITORING STATION

D) THE INDEX OF THE QUALITY OF AIR (IQUA)

The method for determining air quality indices has been changed from previous years, where the 98th percentile and the average of the three highest pollutant indices were used. An Ad Hoc Subcommittee on Air Quality Indices, in a December 1990 report to the Federal-Provincial Advisory Committee on Air Quality, has recommended formulas to assign air quality indices for all the pollutants for which National Objectives have been set. A general description of the IQUA is as follows:

SHORT TERM INDEX

The index is derived from Canadian National Air Quality Objectives and provides a scale consistent with all areas in Canada. Effects, such as on health, vegetation, and public perception, provide the bases for establishing the index. In some cases, the effects may not be easily observed by the general public.

Determining the Index

The concentrations of the individual pollutants are converted to a common scale such that an IQUA value of 0 corresponds to a zero level; a value of 25 to a level equal to the Maximum Desirable Air Quality Objective (MDL); a value of 50 to a level equal to the Maximum Acceptable Objective (MAL); and a value of 100 to a level equal to the Maximum Tolerable Objective (MTL). The maximum determined sub-index is the value of the IQUA. The index indicates the worst effect of the pollutants being monitored. The breakpoints between the

various Objective levels describing the general air quality are shown as follows:

Breakpoint Description	Objective Level	Numerical Value
GOOD	MDL	25
FAIR	MAL	50
POOR	MTL	100

ANNUAL INDEX

The annual index is in the same form and consistent with the short term index. It reflects the long term air quality, indicates trends, and permits comparison with other areas in Canada. The annual index is the average value of the short term indices measured throughout the year, and is represented by the histograms shown in Figures 48 and 49.

Winnipeg Index of the Quality of Air

The IQUA is derived from valid air quality data from two National Air Pollution Surveillance (NAPS) Class 1 stations located in a residential and a downtown area of Winnipeg. The index is designed to describe the general quality of air in the urban areas, not the condition of the air downwind from a specific source of emission.

The frequency distribution of the hourly index values by influencing contaminant, and the annual average index in the downtown and residential areas are shown in Figures 48 and 49, respectively. The annual index was 13.8 in the downtown area and 12.0 in the residential area. The primary influencing

contaminants were O_3 and COH. The air quality was rated as "Good" 96.68% of the time at the downtown site, and rated as "Good" 99.25% of the time at the residential site. The air quality rated as "Poor" only 0.02% of the time at the downtown location. At no time was the air quality rated as "Poor" at the residential site.

RESULTS

EXPLANATION OF DATA STATISTICS

The summary statistics that appear on Tables 3 to 6 are designed to outline, in brief, a profile of annual air pollutant concentration levels at specific sites with comparison to Manitoba Air Quality Criteria.

Each pollutant is addressed by name and a unique pollutant number. Immediately below the pollutant is the indication of the units in which the air pollutant concentration levels are reported. Each air sampling site is identified by a station number and location. More information on the specific sampling site can be found by referring to Table 2.

The quantity of data available from which the calculated statistics are drawn is indicated by the two following references:

"# of months of data" - this refers to the number of months in the year for which at least 75% of the data are valid and available (not applicable to non-continuous measurements such as TSP, Pb, sulphates, and nitrates).

"Percent of data available" - this refers to the percentage of unit data (e.g. hourly averages) per year that are valid and available.

These two statistics are reflective of representativeness of the data statistics for that year. To representatively reflect annual air quality, two months of each quarter and 75% of the total annual data should be available for statistical calculation.

The "Percentile Distribution" is the data distribution of the unit data as shown (i.e. hourly for most pollutants, 24-hour integrated samples for TSP, IP, Pb, SO_4, and NO_3). The pth percentile (e.g.10%) is the pollutant concentration such that p% (e.g. 10%) of the data values are less than that indicated value of pollutant concentration and (100-p)% (e.g. 90%) is greater.

The annual mean is an arithmetic mean (unless otherwise shown) of the available unit data values. The maximum data values are the highest levels present or calculated for the time period listed within the shown year. Other than for the unit data, longer time-based averages are arithmetic and are running averages of consecutive unit data and can overlap for days and/or months. For example, 24-hour running samples are based on increments of one hour and could result in a maximum of 24 x 31 x 12 = 8928 24-hour sampling periods within a year. At least 75% of the data values within one running period must be available for the calculation of that running mean average.

A comparison of the data to the Manitoba Ambient Air Criteria (Table 1) is shown under the heading "# of samples above M.T.L"," ..... above M.A.L.", et al. This listing is a count of the number of time-based averages or unit data concentrations that are larger than the appropriate time-based objective or guideline level.

In Figures 7 to 22, monthly statistics of unit data for all pollutants (except for inhalable particulate, total suspended particulate, and constituents) are plotted through the course of the year to provide a visual representation of key statistics such as monthly means, maximum concentrations, and 99th percentile concentration levels. In addition, objective and guideline levels are identified. Figures 23 to 47 illustrate actual measured levels of inhalable particulate, and total suspended particulate matter (and constituents) through the course of the year.

TABLE 3

MANITOBA AMBIENT AIR QUALITY DATA 1987

ANNUAL POLLUTANT SUMMARY

CARBON MONOXIDE (CO)
PARTS PER MILLION (PPM)

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HOUR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	8-HR	# OF SAMPLES ABOVE M.D.L. 1-HR	8-HR	# OF SAMPLES ABOVE M.A.L. 1-HR	8-HR	# OF SAMPLES ABOVE M.T.L. 1 HR	8-HR
9118	WINNIPEG, SCOTIA & JEFFERSON	12	95	0.1	0.3	0.5	0.7	0.9	3.5	0.4	13.0	5.8	0	8	0	0		0
9119	WINNIPEG, 65 ELLEN STREET	12	91	0.2	0.4	0.7	1.1	1.8	3.3	0.8	10.2	4.1	0	0	0	0		0

NITROGEN DIOXIDE (NO_2)
PARTS PER HUNDRED MILLION (PPHM)

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HOUR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	8-HR	# OF SAMPLES ABOVE M.D.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.A.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.T.L. 1-HR	24-HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	12	92	0.1	0.3	0.5	0.7	1.4	3.0	0.5	10.0	2.7						
9118	WINNIPEG, SCOTIA & JEFFERSON	12	94	0.2	0.6	1.1	1.7	2.9	5.0	1.3	8.5	4.6			0	0	0	
9119	WINNIPEG, 65 ELLEN SREET	12	87	0.8	1.5	2.0	2.6	3.5	5.1	2.1	7.7	5.0			0	0	0	
															0	0	0	

NITRIC OXIDE (NO)
PARTS PER HUNDRED MILLION (PPHM)

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HOUR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	24-HR	# OF SAMPLES ABOVE M.D.L. 1-HR	24HR	# OF SAMPLES ABOVE M.A.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.T.L. 1-HR	24-HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	12	91	0.2	0.6	1.0	1.3	0.3	6.3	0.5	27.5	5.9						
9118	WINNIPEG, SCOTIA & JEFFERSON	12	94	0.2	0.6	1.0	1.4	2.2	14.8	0.9	54.6	14.3						
9119	WINNIPEG, 65 ELLEN STREET	12	89	0.1	0.9	0.3	1.1	4.3	13.9	1.4	58.8	12.8						

NITROGEN OXIDES (NO_X)
PARTS PER HUNDRED MILLION (PPHM)

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HOUR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	24-HR	# OF SAMPLES ABOVE M.D.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.A.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.T.L. 1-HR	24-HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	12	84	0.2	0.5	0.8	1.1	2.1	7.2	0.7	20.0	6.8						
9118	WINNIPEG, SCOTIA & JEFFERSON	12	94	0.3	0.7	1.2	2.2	5.0	18.4	2.3	60.7	18.1						
9119	WINNIPEG, 65 ELLEN STREET	12	89	0.6	1.6	0.9	3.9	7.2	17.8	3.4	64.1	17.0						

AMMONIA (NH_3)
PARTS PER MILLION (PPM)

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HOUR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	24-HR	# OF SAMPLES ABOVE 3.0 PPM 1-HR	# OF SAMPLES ABOVE M.A.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.T.L. 1-HR	24-HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	12	86	0.0	0.0	0.0	0.0	0.0	0.9	0.0	5.5	1.0	3	17			

OXIDANTS-OZONE (O_3)
PARTS PER HUNORED MILLION (PPHM)

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HOUR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	24-HR	# OF SAMPLES ABOVE M.D.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.A.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.T.L. 1-HR	24-HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	12	88	0.8	1.7	2.6	3.3	4.6	6.3	2.5	8.1	5.4	379	6279	0	3820	0	
9118	WINNIPEG, SCOTIA & JEFFERSON	12	86	0.5	1.4	2.1	2.8	3.8	5.1	2.1	6.5	4.3	60	5880	0	1990	0	
9119	WINNIPEG, 65 ELLEN STREET	12	93	0.3	0.9	1.6	2.5	3.8	5.7	1.8	8.1	5.1	160	4468	0	1736	0	

HYDROGEN SULPHIDE (H_2S)
PARTS PER BILLION (PPB)

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HOUR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	24-HR	# OF SAMPLES ABOVE M.D.L. 1-HR	24HR	# OF SAMPLES ABOVE M.A.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.T.L. 1-HR	24-HR
7111	THE PAS PROVINCIAL BUILDING	3	21	0	0	0	0	0	7	0	18	6	141		8	15	0	

SULPHUR DIOXIDE (SO_2)
PARTS PER MILLION (PPM)

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HOUR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	24-HR	# OF SAMPLES ABOVE M.D.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.A.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.T.L. 1 HR	24-HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	4	93	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.01	0	0	0	0		0
9118	WINNIPEG, SCOTIA & JEFFERSON	12	93	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.06	0.01	0	0	0	0		0
9119	WINNIPEG, 65 ELLEN STREET	12	93	0.00	0.00	0.00	0.01	0.01	0.02	0.00	0.10	0.02	0	0	0	0		0
7233	FLIN FLON, 35 MAIN STREET	3	24	0.00	0.00	0.00	0.00	0.03	0.17	0.01	0.54	0.11	17	45	3	0		0
7222	FLIN FLON, CHANNING DRIVE	3	24	0.00	0.00	0.00	0.00	0.00	0.11	0.01	0.80	0.17	14	25	5	22		0
7344	THOMPSON, 59 ELIZABETH ROAD	3	24	0.00	0.00	0.00	0.00	0.00	0.11	0.01	0.53	0.06	13	0	3	0		0

TABLE 5 MANITOBA AMBIENT AIR QUALITY DATA 1987 ANNUAL POLLUTANT SUMMARY (CONT'D)

SOILING INDEX (SMOKE)
COEFFICIENT OF HAZE UNITS PER 1000 FEET (COH)

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HOUR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	24-HR	# OF SAMPLES ABOVE M.D.L. 24-HR	# OF SAMPLES ABOVE M.A.L. 24-HR	# OF SAMPLES ABOVE M.T.L. 24-HR
9118	WINNIPEG, SCOTIA & JEFFERSON	12	71	0.0	0.0	0.1	0.1	0.3	0.7	0.1	1.8	0.5	2	0	
9119	WINNIPEG, 65 ELLEN STREET	12	77	0.0	0.1	0.1	0.3	0.5	0.9	0.2	2.3	0.7	106	0	

TOTAL SUSPENDED PARTICULATE (TSP)
MICROGRAMS PER CUBIC METER (ug/m^3)

STATION NUMBER	STATION LOCATION	# OF SAMPLES	PERCENTILE DISTRIBUTION (24-HOUR INTEGRATED) 10%	30%	50%	70%	90%	99%	ANNUAL GEOMETRIC MEAN	MAXIMUM DATA VALUES 24-HR	# OF SAMPLES ABOVE M.A.I 24-HR	# OF SAMPLES ABOVE M.T.L. 24-HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	16	13	21	29	47	57	61	29	60	0	0
9201	BRANDON, 1104 PRINCESS AVENUE	53	18	31	44	55	79	129	39	132	1	0
4304	ST. FRANCOIS XAVIER (BACKGROUND)	62	5	13	18	31	47	134	18	130	1	0
9102	WINNIPEG, 2120 PORTAGE AVENUE	59	19	30	43	55	72	98	59	98	0	0
9118	WINNIPEG, 299 SCOTIA STREET	216	15	25	35	46	78	152	34	281	6	0
9119	WINNIPEG, 65 ELLEN SREET	248	23	42	62	81	127	224	58	253	28	0

INHALABLE PARTICULATE (IP)
MICROGRAMS PER CUBIC METER (ug/m^3)

STATION NUMBER	STATION LOCATION	# OF SAMPLES	PERCENTILE DISTRIBUTION (24-HOUR INTEGRATED) 10%	30%	50%	70%	90%	99%	ANNUAL GEOMETRIC MEAN	MAXIMUM DATA VALUES 24-HR	# OF SAMPLES ABOVE M.A.L. 24-HR	# OF SAMPLES ABOVE M.T.L. 24-HR
9119	WINNIPEG, 65 ELLEN STREET	56	14	21	26	35	49	93	26	95		

LEAD (Pb)

MICROGRAMS PER CUBIC METER (ug/m^3)

STATION NUMBER	STATION LOCATION	# OF SAMPLES	PERCENTILE DISTRIBUTION (24-HR INTEGRATED) 10%	30%	50%	70%	90%	99%	ANNUAL GEOMETRIC MEAN	MAXIMUM DATA VALUES 24-HR	# OF SAMPLES ABOVE M.A.L. 24-HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	16	0.04	0.04	0.04	0.06	0.12	0.20	0.06	0.19	0
4304	ST. FRANCOIS XAVIER (BACKGROUND)	61	0.04	0.05	0.06	0.07	0.08	0.77	0.06	0.80	0
9102	WINNIPEG, 2120 PORTAGE AVENUE	59	0.02	0.04	0.08	0.12	0.20	0.35	0.09	0.34	0
9118	WINNIPEG, 299 SCOTIA STREET	60	0.04	0.05	0.06	0.09	0.12	0.45	0.07	0.44	0
9119	WINNIPEG, 65 ELLEN STREET	60	0.05	0.08	0.09	0.12	0.14	0.53	0.10	0.54	0
9201	BRANDON, 1104 PRINCESS AVENUE	53	0.03	0.05	0.05	0.07	0.09	0.27	0.06	0.26	0

SULPHATES (SO_4)

MICROGRAMS PER CUBIC METER (ug/m^3)

STATION NUMBER	STATION LOCATION	# OF SAMPLES	PERCENTILE DISTRIBUTION (24-HR INTEGRATED) 10%	30%	50%	70%	90%	99%	ANNUAL GEOMETRIC MEAN	MAXIMUM DATA VALUES 24-HR	# OF SAMPLES ABOVE M.A.L. 24-HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	16	0.69	0.92	1.23	1.92	2.42	4.05	1.32	3.97	
4304	ST. FRANCOIS XAVIER (BACKGROUND)	61	0.38	0.67	1.13	1.58	2.57	4.24	1.04	4.27	
9102	WINNIPEG, 2120 PORTAGE AVENUE	58	0.59	0.98	1.42	1.97	3.08	4.28	1.37	4.19	
9118	WINNIPEG, 299 SCOTIA STREET	60	0.58	0.90	1.32	2.12	3.72	5.22	1.38	5.29	
9119	WINNIPEG, 65 ELLEN STREET	60	0.73	1.30	1.97	2.76	3.96	6.20	1.78	6.27	
9201	BRANDON, 1104 PRINCESS STREET	53	0.64	0.97	1.24	1.68	2.33	7.41	1.28	7.43	

NITRATES (NO_3)

MICROGRAMS PER CUBIC METER (ug/m^3)

STATION NUMBER	STATION LOCATION	# OF SAMPLES	PERCENTILE DISTRIBUTION (24-HR INTEGRATED) 10%	30%	50%	70%	90%	99%	ANNUAL GEOMETRIC MEAN	MAXIMUM DATA VALUES 24-HR	# OF SAMPLES ABOVE M.A.L. 24-HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	16	0.19	0.49	0.97	1.47	2.11	8.91	0.76	8.70	
4304	ST. FRANCOIS XAVIER (BACKGROUND)	61	0.24	0.44	0.60	1.07	2.08	4.63	0.64	4.57	
9102	WINNIPEG, 2120 PORTAGE AVENUE	59	0.22	0.58	0.82	1.19	2.45	7.42	0.82	7.39	
9118	WINNIPEG, 299 SCOTIA STREET	60	0.19	0.45	0.71	1.08	2.58	6.53	0.69	6.55	
9119	WINNIPEG, 65 ELLEN STREET	60	0.25	0.55	0.93	1.42	2.88	9.64	1.02	9.71	
9201	BRANDON, 1104 PRINCESS AVENUE	53	0.20	0.48	0.69	1.01	1.91	5.92	0.67	5.83	

DISCUSSION

Though it was the intent within the design of the sampling network to locate monitoring sites in accord with generally accepted siting criteria and to use collection and analytical procedures that are common to other networks, it should be noted that the data presented in this report may have limitations and, therefore, caution should be exercised towards its use. In particular, when comparing data between Canadian regions and even between stations in the same city, it must be realized that the data represents the condition of the air in the vicinity of the individual monitoring station and may not necessarily reflect community-wide air quality.

A. WINNIPEG AIR QUALITY

Downtown

Air quality in the downtown area of Winnipeg was represented by monitoring at station #9119, 65 Ellen Street, a NAPS Class 1 site. Measurements were made for the parameters sulphur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), nitric oxide (NO), nitrogen oxides (NO_x), ozone (O_3), soiling index (coefficient of haze-COH), total suspended particulate (TSP), inhalable particulate (IP), lead (Pb), sulphates (SO_4), and nitrates (NO_3).

SO_2 levels downtown during 1987 continued to be low as in previous years, and at undetectable or trace concentrations. No levels above any of the Provincial Criteria were recorded. The highest 1-hour concentration measured was 0.10 ppm on February 14, 1987. The highest 24-hour average concentration was

measured at 0.01 ppm.

CO levels at station #9119 were similar to levels measured in 1986, although maximum levels were slightly lower. Maximum values were 10.2 ppm for the 1-hour average and 4.1 ppm for the 8-hour average [compared to 11.3 ppm and 5.6 ppm, respectively, in 1986]. None of the Provincial Criteria were exceeded in 1987, a marked difference from previous years. In 1986 the 8-hour MDL was exceeded on 10 occasions. Average levels of CO in the downtown area were higher than those observed in the residential area, even though maximum levels were lower, as can be seen in Figures 7 and 8.

NO_2 levels in downtown Winnipeg continued to be well below the Manitoba Air Quality Objectives. The maximum values recorded were 7.7 pphm for the 1-hour and 5.0 pphm for the 24-hour time periods; these values were lower than those found in 1986. The annual mean was 2.1 pphm, a slight increase from previous years (Figure 10).

NO and NO_x annual mean concentrations were 1.4 pphm and 3.4 pphm, respectively. The levels for these parameters were not reported in 1986. Manitoba has no Air Quality Objectives or Guidelines for NO.

O_3 levels at the downtown station had the lowest annual mean (1.8 pphm), of the three stations that monitored ozone in Manitoba, although the maximums were similar to those found at the site in Brandon (Figures 12, 13, and 14). The maximum 1-hour ozone value was 8.1 pphm and the maximum 24-hour value was 5.1 pphm; both of these levels were slightly higher than those reported in previous years. In 1987 the 1-hour MAL of 8.2 pphm was not exceeded. The 24-hour MAL, and both the 1-hour and 24-hour MDL were exceeded on numerous occasions.

Soiling index values were measured as coefficient of haze (COH) units per 1000 feet for a 2-hour sampling period until March 1, 1987, when equipment changes warranted a 1-hour sampling period. Values at the downtown site were

similar to those found at the residential site (Figures 15 and 16), and also similar to those found in previous years. The maximum 1-hour value recorded was 2.3 COH units which occurred on September 21, 1987. The maximum 24-hour level recorded was 0.7 COH units, which occurred during August and September. These values were similar to those found in 1986. During the year the 24-hour MDL of 0.45 COH units was exceeded 106 times (twice as often as in 1986), mostly during the fall months; a majority of these values seem to be related to smoke-in-air from agricultural stubble burning.

TSP levels in downtown Winnipeg (Figure 24) were the highest of all sites (similar to observations in previous years). As in 1986, this site was sampled at an increased frequency for a total of 248 days. This enhanced sampling (compared to once every six days as per NAPS cycle) may be providing greater resolution than at the other sites which operate at the standard sampling frequency. The annual geometric mean at this site was 58 ug/m^3, and was below both the annual MDL and MAL Air Quality Criteria of 60 ug/m^3 and 70 ug/m^3, respectively. The maximum 24-hour level recorded was 253 ug/m^3 on April 9, 1987. Of the total samples collected, 28 (11%) exceeded the 24-hour MAL of 120 ug/m^3. All of these levels were similar to those found in 1986 and arose primarily from vehicle-raised dust on city streets.

IP levels were also monitored at the downtown station and reported for the first time. The results are shown in Figure 29. Objectives or Guidelines for this parameter have not been established.

Pb levels within the downtown area (Figure 31) were well below the 24-hour MAL of 5.0 ug/m^3. The annual geometric mean of 0.10 ug/m^3, and the maximum 24-hour level of 0.54 ug/m^3, were similar to those levels found in 1986.

SO_4 levels at station #9119 (Figure 37) had an annual 24-hour average of 1.78 ug/m^3, with a maximum of 6.27 ug/m^3. These levels were slightly lower than

those found in 1986 at this location. There are no Manitoba Air Quality Guidelines or Objectives for this parameter.

NO_3 concentrations at station #9119 (Figure 43) averaged at 1.02 ug/m^3 for the annual mean, with a maximum of 9.71 ug/m^3. These were the highest levels of all the sites in Manitoba with the annual average level slightly increased, and the maximum level slightly decreased from 1986. As with sulphates, there are no Manitoba Air Quality Guidelines or Objectives for this parameter.

Based on the annual Index of the Quality of Air (IQUA), air quality in downtown Winnipeg was rated as being "Good" most of the time, with an annual average index of 13.8. This was slightly higher than at the residential location. The frequency distribution of hourly index values, and the annual average index are shown in Figure 48.

Residential

The description of Winnipeg residential air quality is based on sampling conducted at station #9118 (299 Scotia Street), a NAPS Class 1 site. The parameters measured at this site were: SO_2, CO, NO_2, NO, NO_x, O_3, COH, TSP, Pb, SO_4, and NO_3.

SO_2 concentrations in the residential area of Winnipeg continued to be well below Ambient Air Quality Objectives, as in previous years, at undetectable levels or trace concentrations. The maximum 1-hour level at this site was 0.06 ppm and the maximum 24-hour average was 0.01 ppm.

CO levels at station #9118, on average, were slightly lower than those in the downtown area, whereas the maximum levels were higher (Figures 7 and 8). The annual mean was 0.4 ppm (0.8 ppm downtown) and the maximum levels were 13.0 ppm

and 5.8 ppm for the 1-hour and 8-hour averages, respectively. There were 8 excursions above the 8-hour MDL, recorded at this site in November and December of 1987. These levels were similar to those found in previous years, although the number of exceedences had increased.

NO_2 levels, on average, were lower than those measured downtown (Figures 9 and 10). The maximum 1-hour level recorded was 8.5 pphm and the maximum 24-hour level recorded was 4.6 pphm. These levels were similar to those found in 1986. All recorded levels were below the Ambient Air Quality Criteria.

NO and NO_x annual mean concentrations were 0.9 pphm and 2.3 pphm, respectively, lower than at the downtown station. These parameters were not reported in 1986. Ambient Air Quality Criteria for NO have not been established.

O_3 levels at site #9118 (Figure 12) had a slightly higher annual average (2.1 pphm) than at the downtown site, although the maximum levels were lower. The maximum 1-hour level recorded was 6.5 pphm and the maximum 24-hour average was 4.3 pphm. The 1-hour MAL of 8.2 pphm was not exceeded at this location. The frequent excursions above the 1-hour MDL and the 24-hour criteria (both MDL and MAL) occurred at this location as well as other sites. The levels found at this site in 1987 were similar to those found in 1986.

COH values at site #9118 (Figure 15) were, in general, lower than those found at the downtown site, and were slightly lower than the levels found in 1986. The maximum 1-hour level was 1.8 COH units and the maximum 24-hour average was 0.5 COH units. There were two excursions above the 24-hour MDL of 0.45 COH units, both in November, 1987; and again these were thought to be related to smoke-in-air from agricultural stubble burning.

TSP levels at site #9118, as at the downtown site, were sampled at an increased frequency for a total of 216 days (Figure 23). This enhanced sampling may be providing greater resolution than is being obtained at the other sites,

and in previous years at this site. The annual geometric mean at this site was 34 ug/m^3, less than that found at site #9119 (58 ug/m^3). The 24-hour maximum level was the highest at this site at 281 ug/m^3, and the 24-hour MAL was exceeded on 6 occasions.

Pb levels at site #9118 (Figure 30) were well below the 24-hour Ambient Air Quality Criteria. The maximum 24-hour level was 0.44 ug/m^3, and the annual geometric mean was 0.07 ug/m^3. In general, readings were similar to previous years at this location, and appear to be lower than in the downtown and roadside areas.

SO_4 and NO_3 concentrations at site #9118 (Figures 36 and 42) were, generally, similar to those measured in other areas of the city. No Air Quality Guidelines or Objectives have been established for these parameters.

Based on the annual Index of the Quality of Air (IQUA), air quality at the residential location was rated as "Good" most of the time, with an annual average index of 12.0. This was slightly better than at the downtown location. The frequency distribution of hourly index values, and the annual average index are shown in Figure 49.

Roadside

Air quality in the vicinity of areas with high density traffic is represented by data from site #9102 (NAPS Class 2), where monitoring was conducted for TSP, Pb, SO_4, and NO_3.

TSP levels at site #9102 (Figure 25) had a similar annual geometric mean of 59 ug/m^3 as at the downtown site, and was higher than that found in previous years. The maximum 24-hour level was 98 ug/m^3, lower than the downtown site, and there were no excursions above the 24-hour MAL.

Pb levels at site #9102 (Figure 32) had a similar annual geometric mean as the downtown site, and as in 1986. The maximum 24-hour level was 0.34 ug/m^3, a marked decrease from 1986, when when the 24-hour maximum was the highest in Manitoba at 1.31 ug/m^3. These levels were well below the Manitoba Air Quality Guideline for Pb of 5.0 ug/m^3.

SO_4 and NO_3 levels at site #9102 (Figures 38 and 44) were similar to those at other Winnipeg sites, and those found in 1986.

Background

Background levels of TSP, Pb, SO_4, and NO_3, were monitored at site #4304 in St. Francois-Xavier, a small community located approximately 7 km west of Winnipeg's city limits.

TSP levels at this site (Figure 26) were the lowest of all monitoring sites (annual geometric mean of 18 ug/m^3). This background level was similar to that found in 1986 (19 ug/m^3). The 24-hour MAL was exceeded once on June 14, 1987, with a maximum value of 130 ug/m^3.

Pb levels at St. Francois-Xavier (Figure 33) were, on average, lower than those in Winnipeg, although the highest level in Manitoba was recorded at this site. No explanation can be provided for this occurrence. The annual mean was 0.06 ug/m^3, and the maximum 24-hour level recorded was 0.80 ug/m^3. These levels were higher than those found in 1986, but remained well below the 24-hour MAL for Pb.

SO_4 levels at site #4304 (Figure 39), on average, were lower than any other site in Manitoba, with an annual geometric mean of 1.04 ug/m^3. The maximum 24-hour level found was 4.27 ug/m^3.

NO_3 levels at this site (Figure 45) were lower than those found at Winnipeg sites, but similar to those found in Brandon. The annual geometric mean was 0.64 ug/m^3 and the 24-hour maximum was 4.57 ug/m^3.

B. BRANDON AIR QUALITY

Downtown

Air quality in downtown Brandon was sampled for TSP, Pb, SO_4, and NO_3 at site #9201 (1104 Princess Avenue), a NAPS Class 2 site. TSP annual geometric mean levels at this site (Figure 27) were similar to those at Winnipeg site #9118. The annual average was 39 ug/m^3, higher than that found in 1986 (28 ug/m^3). The maximum 24-hour value was 132 ug/m^3 recorded on May 15, 1987; this was the only value to exceed the 24-hour MAL of 120 ug/m^3.

Pb levels in downtown Brandon (Figure 34) had an annual geometric mean of 0.06 ug/m^3, slightly higher than that found 1986, but still between those values measured at Winnipeg's background and residential sites. The levels were well below Provincial Criteria.

SO_4 and NO_3 levels in downtown Brandon were also slightly higher than those found in 1986, but but still remain lower than those found at Winnipeg's residential site (Figures 40 and 46).

Industrial

Air quality in the eastern industrial area of Brandon was monitored at station #5131 on the grounds of Assiniboine Community College. This station

monitors NO_x, NO_2, NO, O_3, and NH_3. Monitoring for SO_2, TSP, Pb, SO_4, and NO_3 was started in September, 1987.

NO_2 levels at station #5131 (Figure 11) were lower than those found at the Winnipeg sites, but had the highest 1-hour maximum value of 10.0 pphm. No levels at this site exceeded the MAL Criteria of 21.3 pphm.

NO_x and NO concentrations were also monitored at station #5131. The annual mean values were found to be 0.7 pphm and 0.5 pphm, respectively, lower than that found in 1986. No Manitoba Air Quality Guidelines or Objectives have been established for NO.

O_3 levels measured at Brandon site #5131 (Figure 14) were found to have the highest annual average (2.5 pphm) of all stations. Maximum values measured were similar to those found at the Winnipeg downtown site. These levels were slightly lower than in 1986. There were no excursions above the 1-hour MAL of 8.2 pphm, and many excursions above the 24-hour MAL of 2.5 pphm.

NH_3 monitoring at station #5131 (Figure 17) is source-specific for air emissions from a fertilizer manufacturer. Background levels of NH_3 are undetectable and reported as being 0.00 ppm. The maximum recorded levels at this site were 5.5 ppm (1-hour) and 1.0 ppm (24-hour). The MAL Guideline of 2.0 ppm for any one hour period was exceeded on seventeen occasions (Figure 18). The Manitoba Clean Environment Commission regulatory limit issued to the fertilizer company of 3.0 ppm (1-hour average) was exceeded on only 3 occasions.

SO_2 monitoring was started at the Brandon site #5131 in September, 1987, allowing for 4 months of data to be collected. Most levels recorded were 0.00 ppm, with an hourly maximum level of 0.02 ppm.

A High Volume Sampler was also set up on the roof of the College to monitor for TSP, Pb, SO_4, and NO_3 on a six day cycle. The maximum 24-hour value recorded for TSP was 60 ug/m^3, being the lowest of all stations. Monitoring was

conducted only in the last 4 months of 1987 (Figure 28), and the highest results are usually found in the spring of each year.

The Pb and SO_4 levels were also the lowest of all stations (Figures 35 and 41). The maximum 24-hour NO_3 value was found to be 8.70 ug/m^3 (Figure 47), second only to that at the Winnipeg downtown site which was 9.71 ug/m^3.

C. THE PAS AIR QUALITY

Hydrogen sulphide (H_2S) was the only air quality parameter measured in The Pas. The monitoring was conducted at the Provincial Building at the corner of 3rd Street and Ross Avenue in the downtown area. The primary source of H_2S (and other reduced sulphurs) in the community is a kraft pulp and paper mill located approximately 5 km NE of the town. Annual emissions of total reduced sulphurs have been previously estimated to be about 1 kilotonne per year (Air Standards and Studies, 1988). Monitoring at this site was terminated in April, 1987 due to changing program priorities, and only 3 months of data were available for 1987 (Figure 22). Within this period there were 8 excursions above the 1-hour MAL of 11.0 ppb, and 15 excursions above the 24-hour MAL of 4.0 ppb. The maximum data values were 18 ppb (1-hour) and 6 ppb (24-hour).

D. FLIN FLON AIR QUALITY

SO_2 was monitored in Flin Flon by the Province at two locations:

a) site #7233 located in downtown Flin Flon at 35 Main Street

b) site #7222 located at Channing Drive near the outskirts of town

Monitoring at these sites was terminated in April, 1987, due to changing program priorities, and only three months of data were available for 1987 (Figures 19 and 20).

The primary source of SO_2 is a major zinc-copper smelter located in the downtown area, straddling the Manitoba-Saskatchewan border. This company maintains one monitoring site of its own. Reported SO_2 emissions for 1987 from this complex were 287,703 tonnes per year (Schultz, 1990). At the downtown site there were 3 excursions above the 1-hour MAL of 0.34 ppm, and none above the 24-hour MAL of 0.11 ppm. Maximum data values were 0.54 ppm (1-hour) and 0.11 ppm (24-hour). At the Channing Drive site there were 5 excursions above the 24-hour MAL. The maximum data values recorded were 0.80 ppm (1-hour) and 0.17ppm (24-hour).

E. THOMPSON AIR QUALITY

SO_2 was the only air pollutant monitored in Thompson by the Province. The one site (#7344) is located within the Thompson Provincial Building at 59 Elizabeth Road, about 2.9 km from a major nickel-copper smelter, which is south of the town. Reported SO_2 emissions from this complex during 1987 were 251,649 tonnes per year (Schultz, 1990). An additional air monitoring station to measure SO_2 is also maintained by the Company within the City of Thompson.

Again, due to changing priorities, monitoring was terminated at this site in April, 1987, giving only 3 months of available data (Figure 21). During this period there were 3 excursions above the Provincial 1-hour MAL, and none above the 24-hour MAL. The maximum data values recorded were 0.53 ppm (1-hour) and 0.06 ppm (24-hour).

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Ad Hoc Subcommittee on Air Quality Indices. Report to the Federal-Provincial Advisory Committee on Air Quality, December, 1990.

APPENDIX

CARBON MONOXIDE (CO)
WINNIPEG, SCOTIA & JEFFERSON #9118
1-Hour Samples

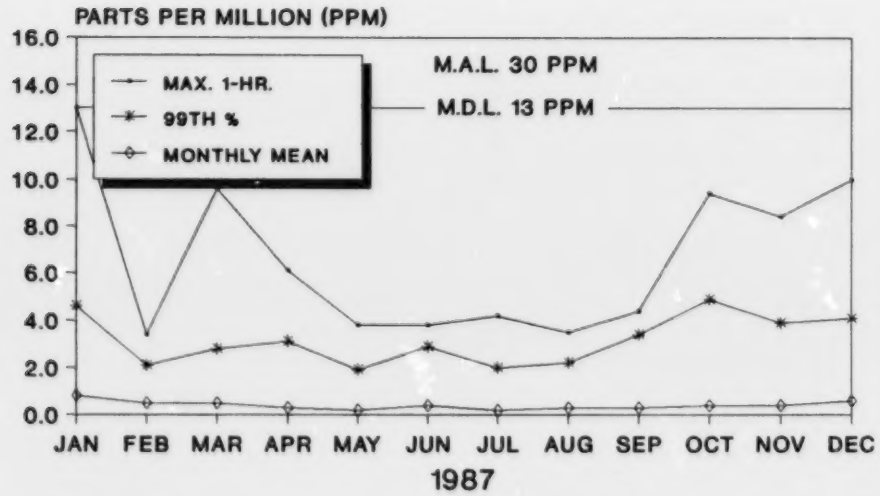


Figure 7

CARBON MONOXIDE (CO)
WINNIPEG, 65 ELLEN ST. #9119
1-Hour Samples

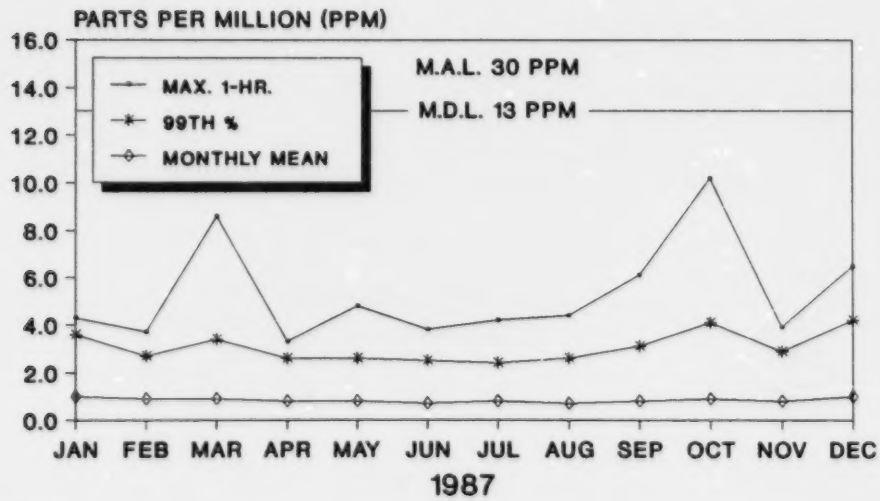


Figure 8

NITROGEN DIOXIDE (NO_2)
WINNIPEG, SCOTIA & JEFFERSON #9118
1-Hour Samples

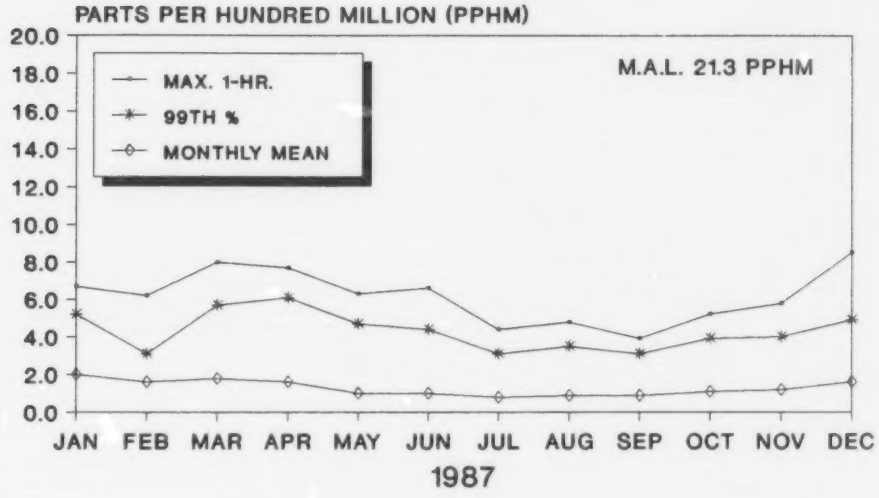


Figure 9

NITROGEN DIOXIDE (NO_2)
WINNIPEG, 65 ELLEN ST. #9119
1-Hour Samples

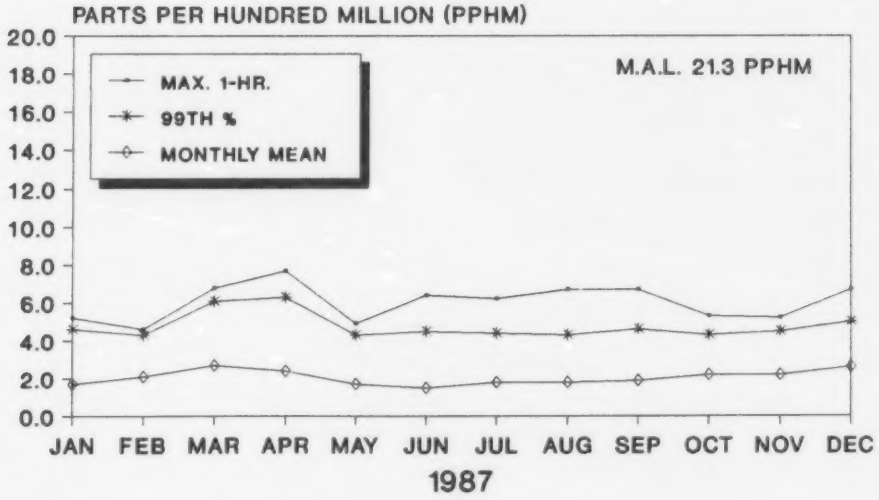


Figure 10

NITROGEN DIOXIDE (NO_2)
BRANDON ASSN. COMM. COLLEGE #5131
1-Hour Samples

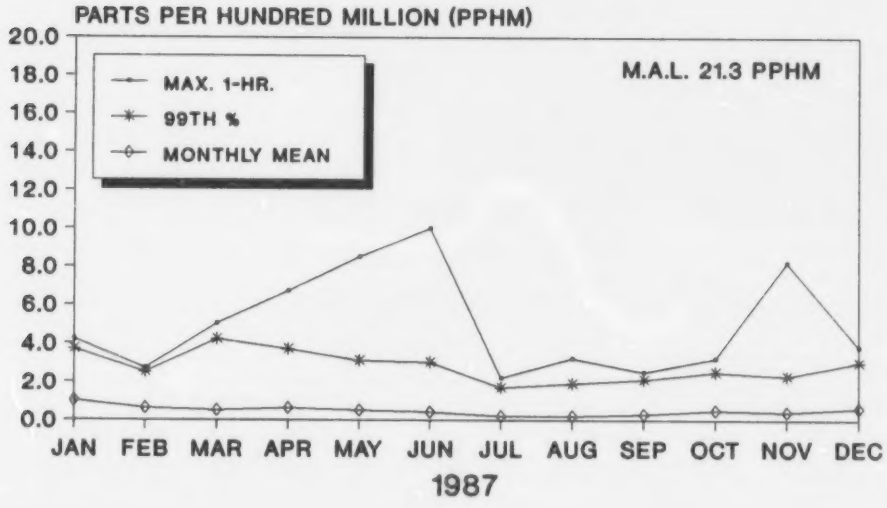


Figure 11

OZONE (O_3)
WINNIPEG, SCOTIA & JEFFERSON #9118
1-Hour Samples

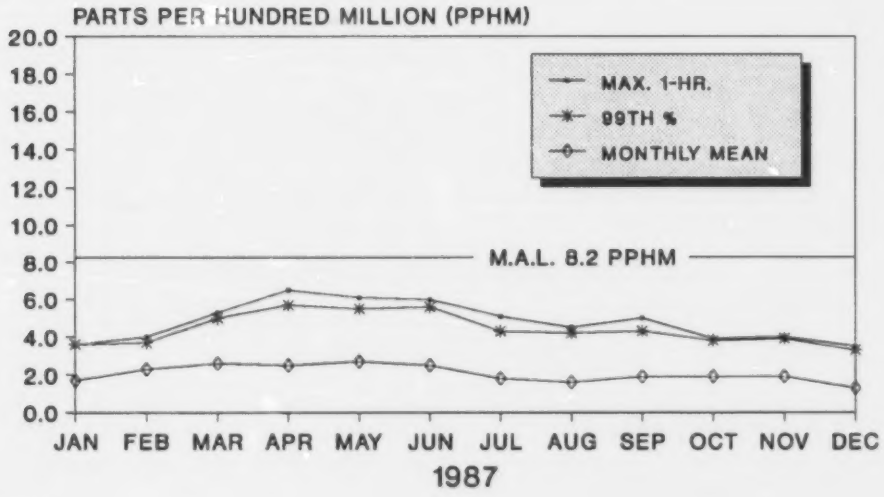


Figure 12

OZONE (O_3)
WINNIPEG, 65 ELLEN ST. #9119
1-Hour Samples

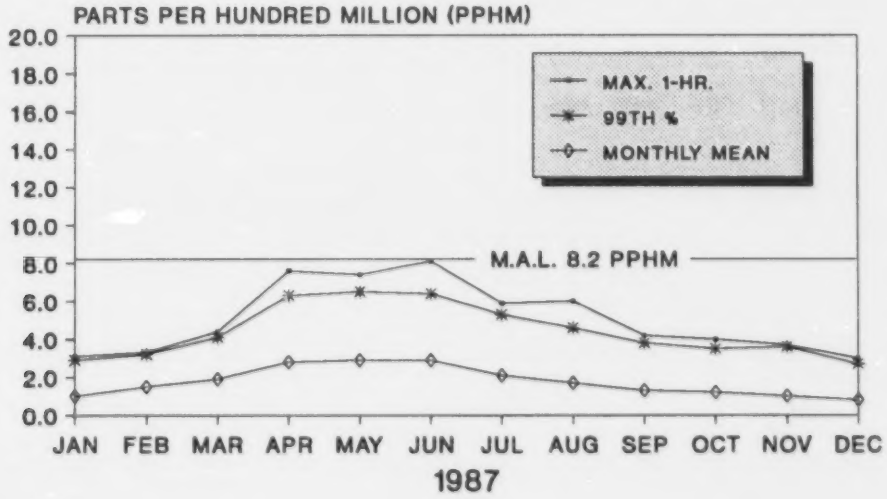


Figure 13

OZONE (O_3)
BRANDON ASSN. COMM. COLLEGE #5131
1-Hour Samples

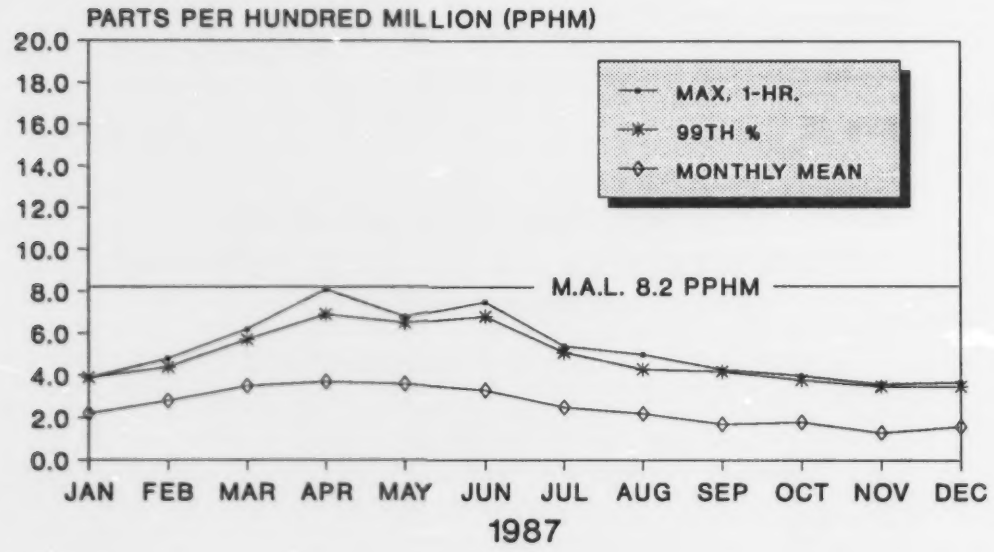


Figure 14

SOILING INDEX (COH)
WINNIPEG, SCOTIA & JEFFERSON #9118
2-Hour Samples

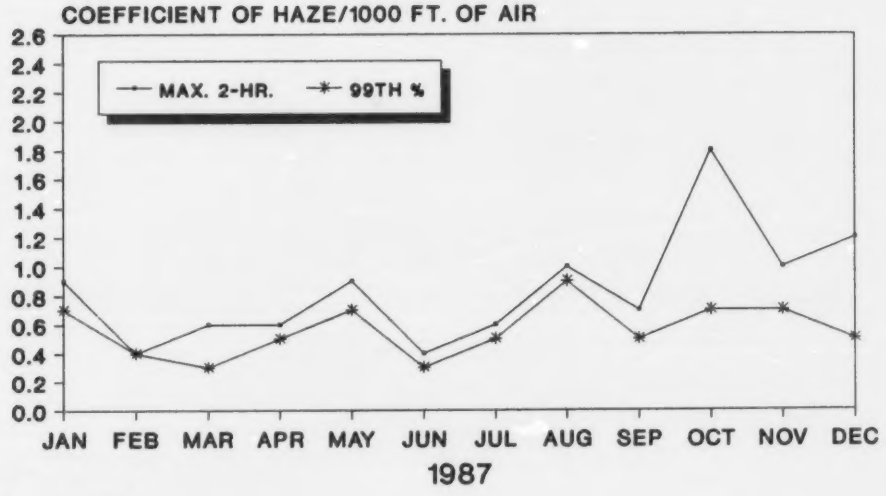


Figure 15

SOILING INDEX (COH)
WINNIPEG, 65 ELLEN ST. #9119
2-Hour Samples

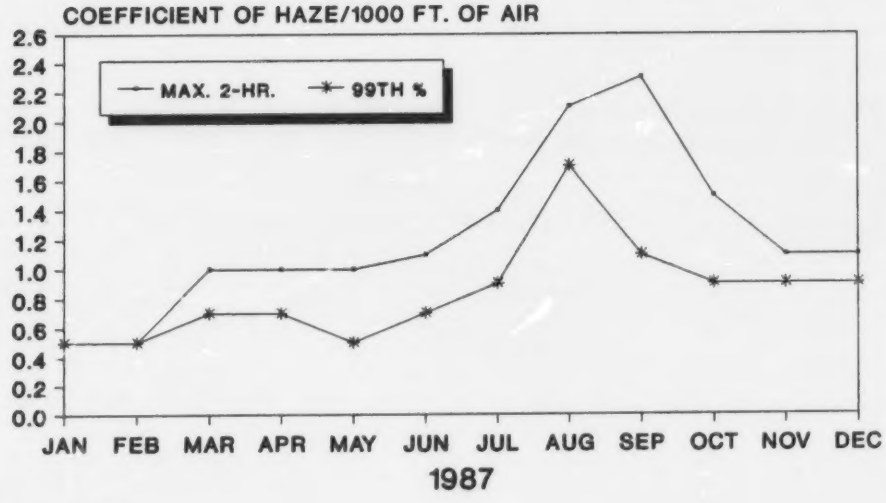


Figure 16

AMMONIA (NH_3)
BRANDON ASSN. COMM. COLLEGE #5131
1-Hour Samples

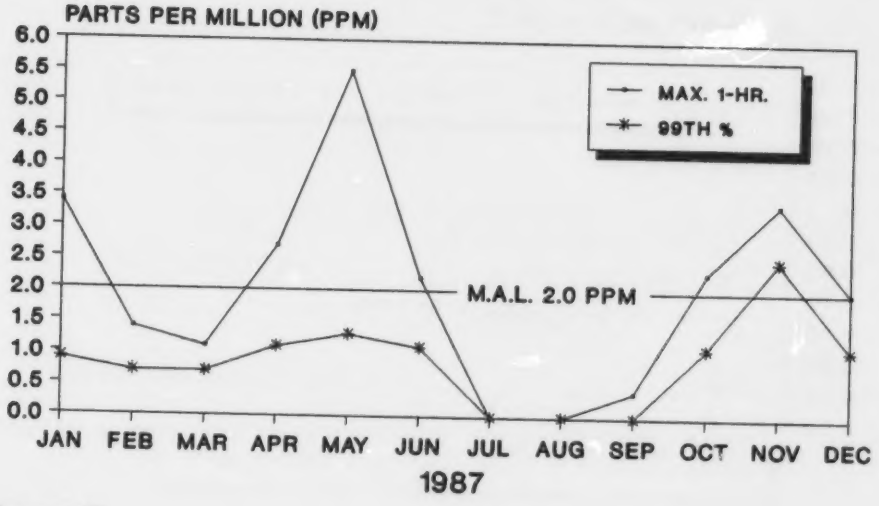


Figure 17

AMMONIA EXCEEDENCES
BRANDON ASSN. COMM. COLLEGE #5131
1-Hour Samples

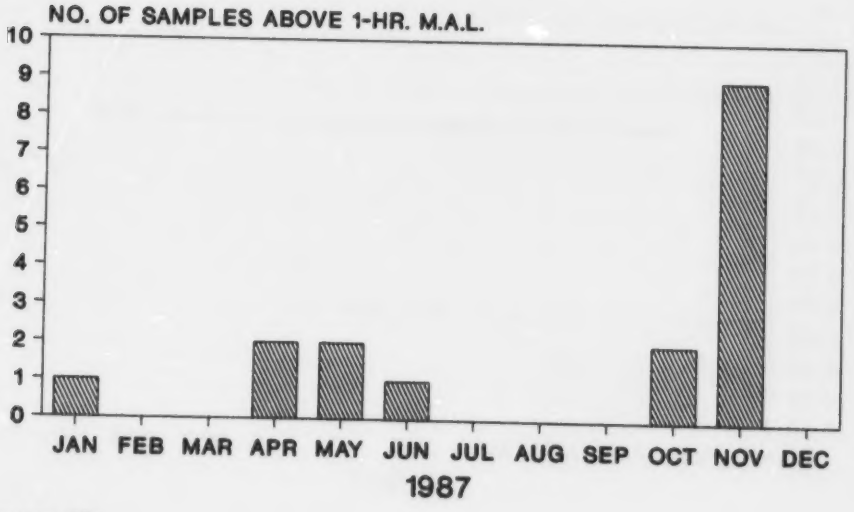


Figure 18

SULPHUR DIOXIDE (SO_2)
FLIN FLON - DOWNTOWN #7233
1-Hour Samples

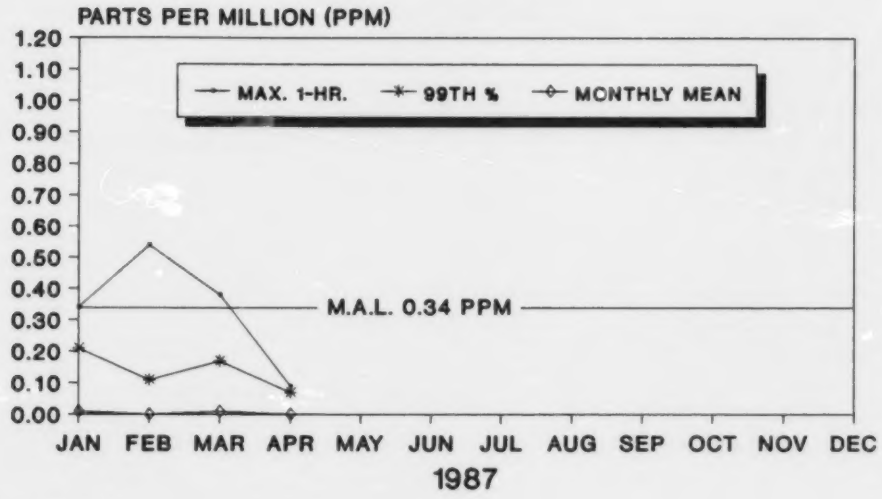


Figure 19

SULPHUR DIOXIDE (SO_2)
FLIN FLON - CHANNING #7222
1-Hour Samples

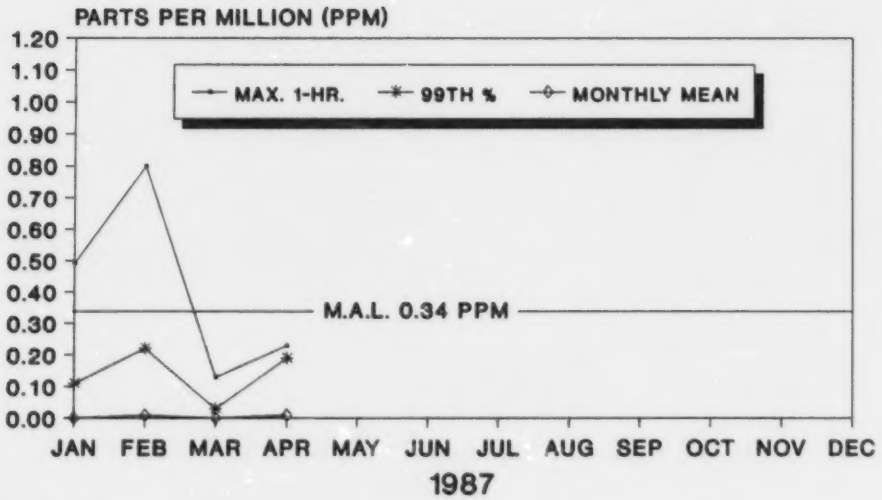


Figure 20

SULPHUR DIOXIDE (SO_2)
THOMPSON, 59 ELIZABETH DR. #7344
1-Hour Samples

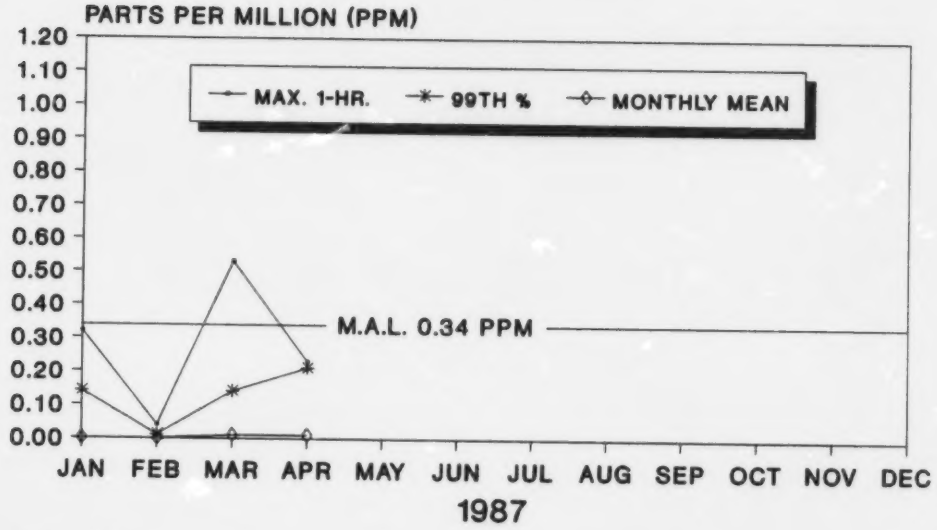


Figure 21

HYDROGEN SULPHIDE (H_2S)
THE PAS PROV. BLDG. #7111
1-Hour Samples

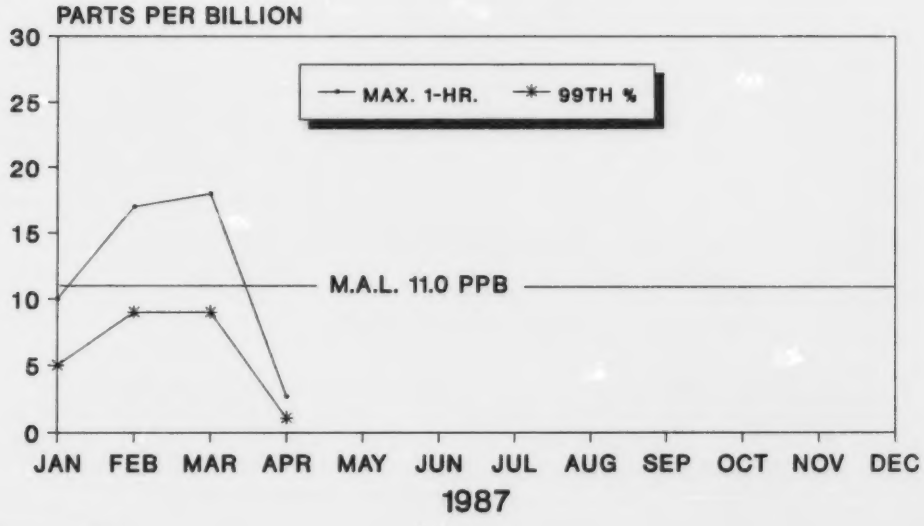


Figure 22

TOTAL SUSPENDED PARTICULATE
WINNIPEG, SCOTIA & JEFFERSON #9118
24-Hour Samples

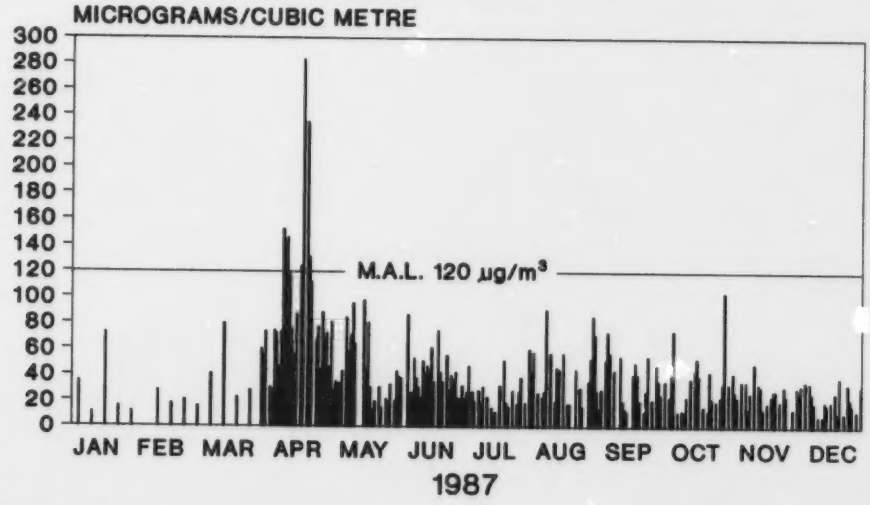


Figure 23

TOTAL SUSPENDED PARTICULATE
WINNIPEG, 65 ELLEN ST. #9119
24-Hour Samples

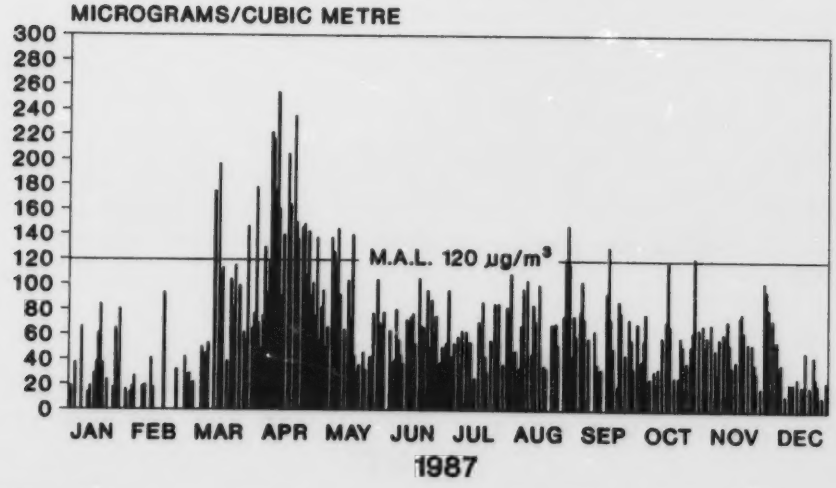


Figure 24

TOTAL SUSPENDED PARTICULATE
WINNIPEG, 2120 PORTAGE AVE. #9102
24-Hour Samples

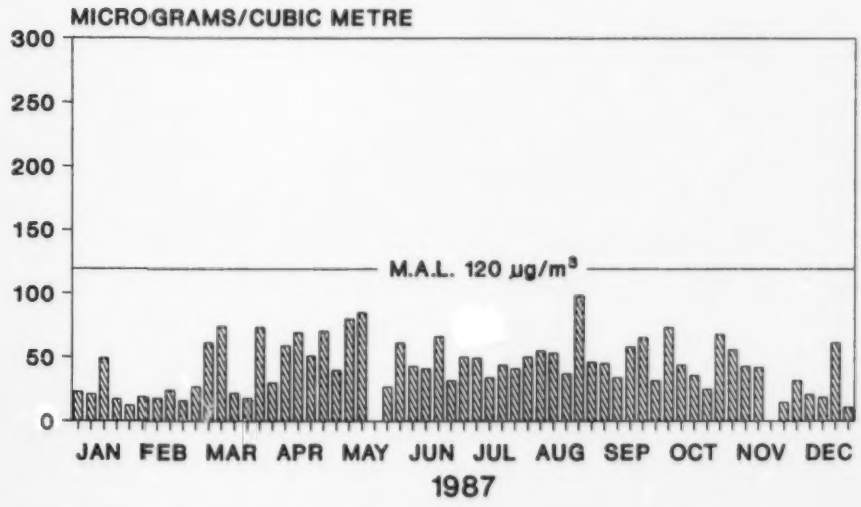


Figure 25

TOTAL SUSPENDED PARTICULATE
ST. FRANCOIS-XAVIER #4304
24-Hour Samples

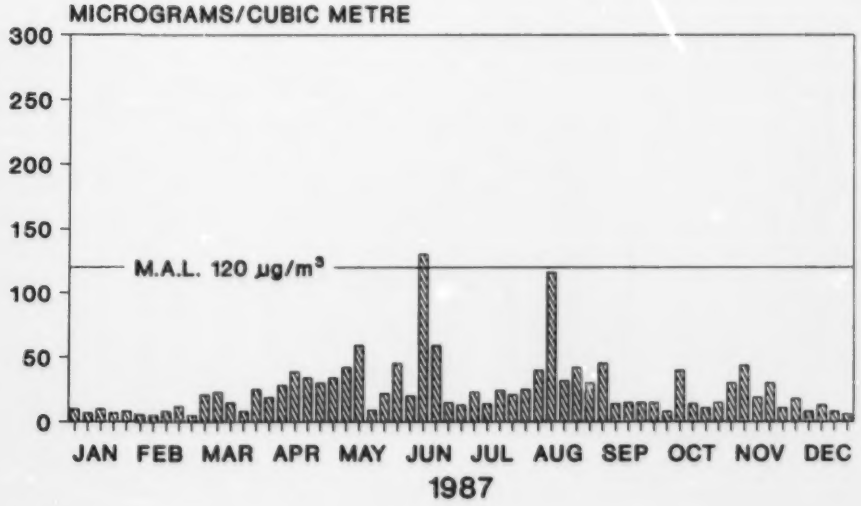


Figure 26

TOTAL SUSPENDED PARTICULATE
BRANDON, 1104 PRINCESS AVE. #9201
24-Hour Samples

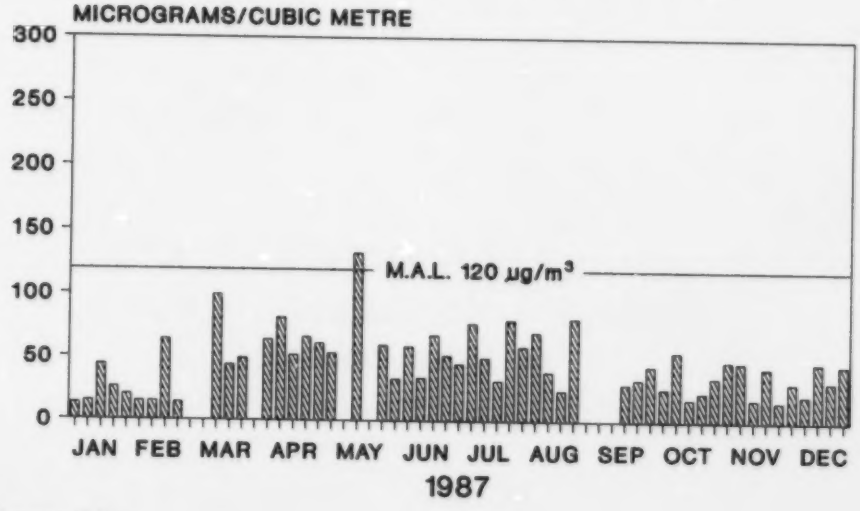


Figure 27

TOTAL SUSPENDED PARTICULATE
BRANDON ASSN. COMM. COLLEGE #5131
24-Hour Samples

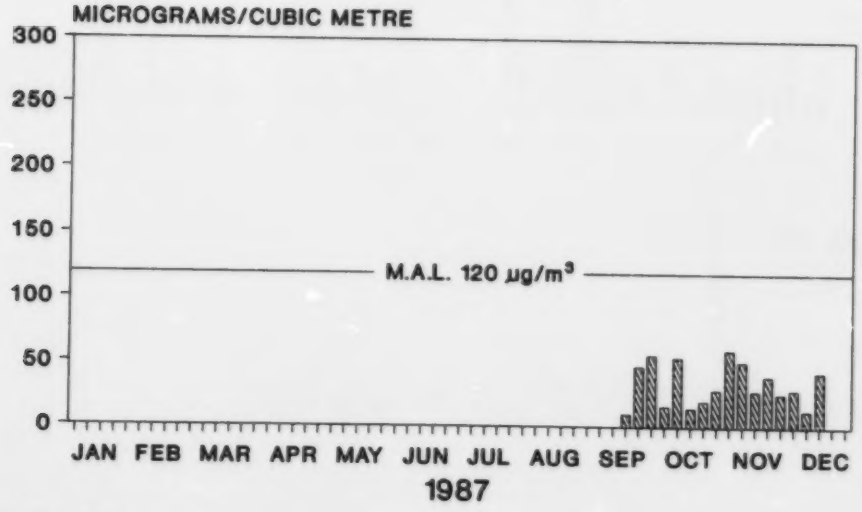


Figure 28

INHALABLE PARTICULATE
WINNIPEG, 65 ELLEN ST. #9119
24-Hour Samples

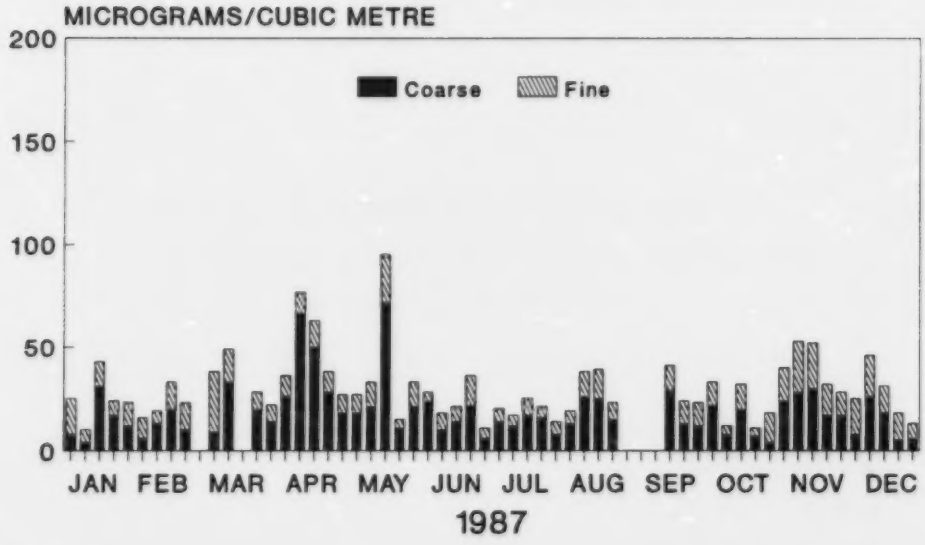


Figure 29

LEAD
WINNIPEG, SCOTIA & JEFFERSON #9118
24-Hour Samples

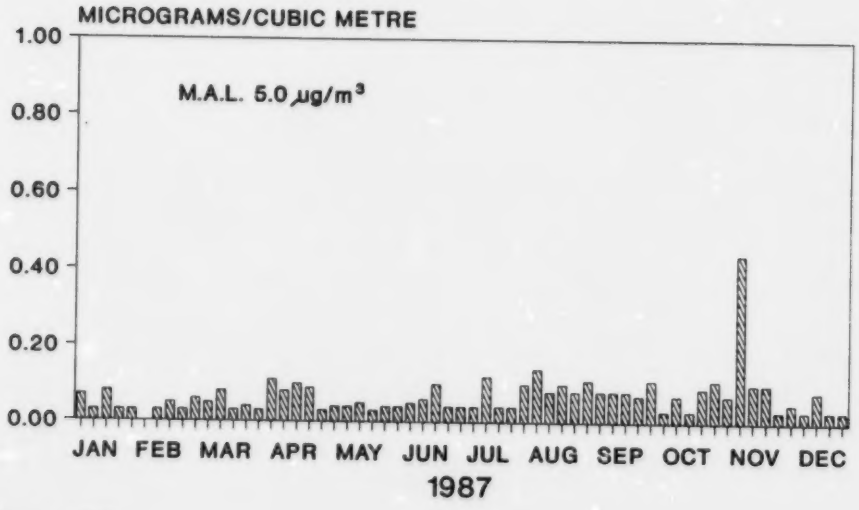


Figure 30

LEAD
WINNIPEG, 65 ELLEN ST. #9119
24-Hour Samples

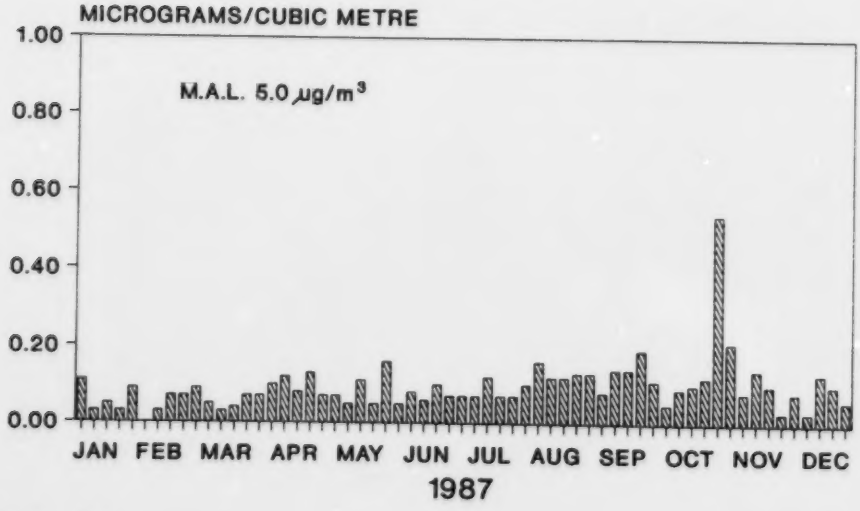


Figure 31

LEAD
WINNIPEG, 2120 PORTAGE AVE. #9102
24-Hour Samples

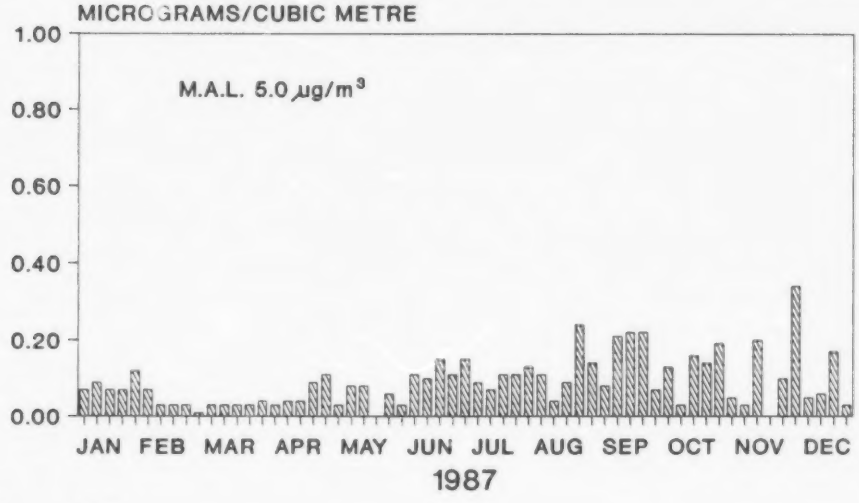


Figure 32

LEAD
ST. FRANCOIS-XAVIER #4304
24-Hour Samples

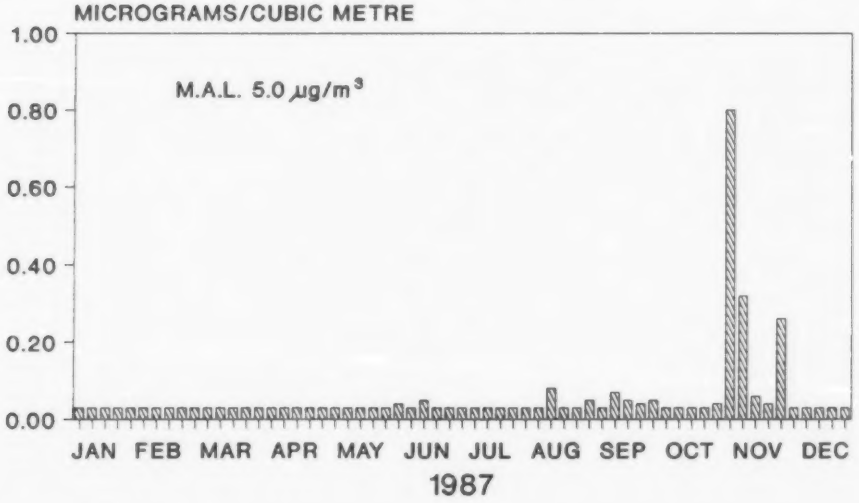


Figure 33

LEAD
BRANDON, 1104 PRINCESS AVE. #9201
24-Hour Samples

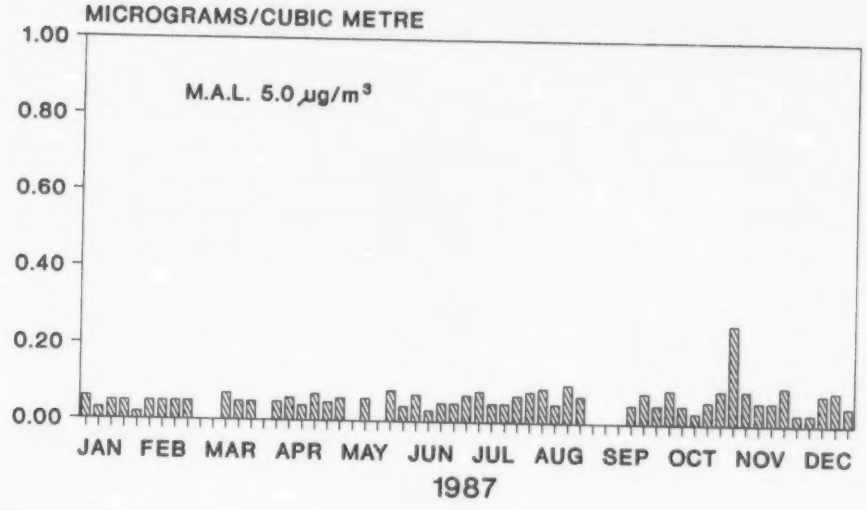


Figure 34

LEAD
BRANDON ASSN. COMM. COLLEGE #5131
24-Hour Samples

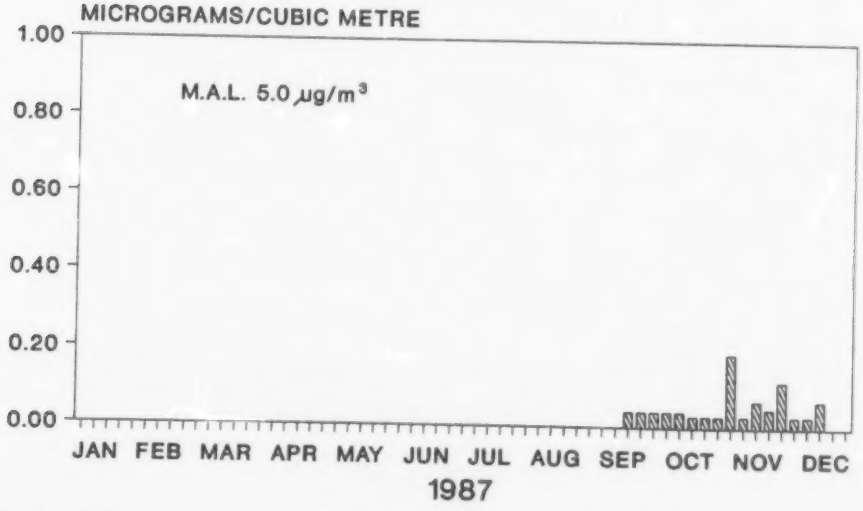


Figure 35

SULPHATE
WINNIPEG, SCOTIA & JEFFERSON #9118
24-Hour Samples

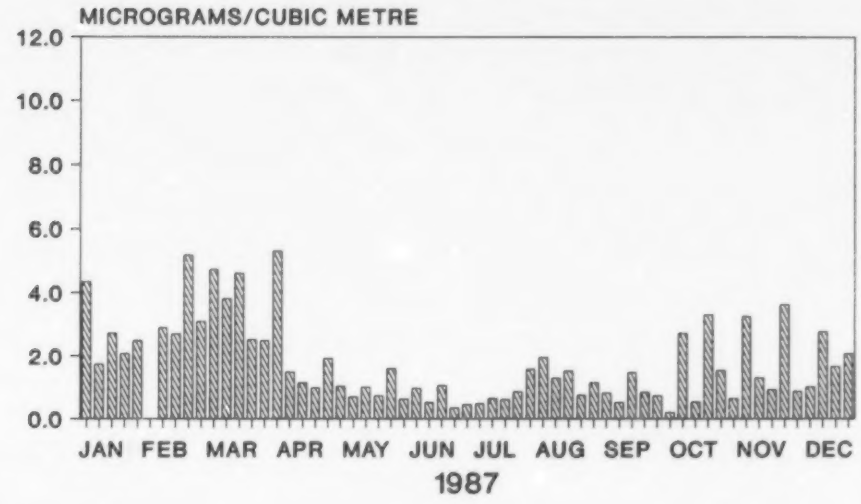


Figure 36

SULPHATE
WINNIPEG, 65 ELLEN ST. #9119
24-Hour Samples

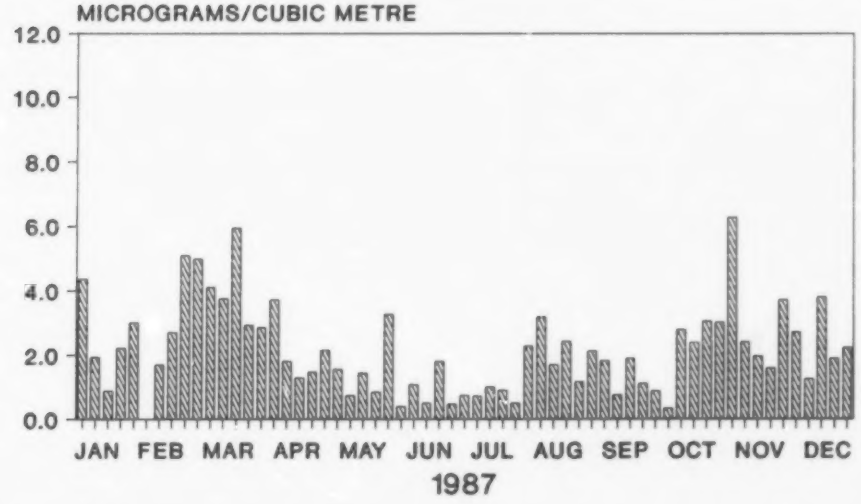


Figure 37

SULPHATE
WINNIPEG, 2120 PORTAGE AVE. #9102
24-Hour Samples

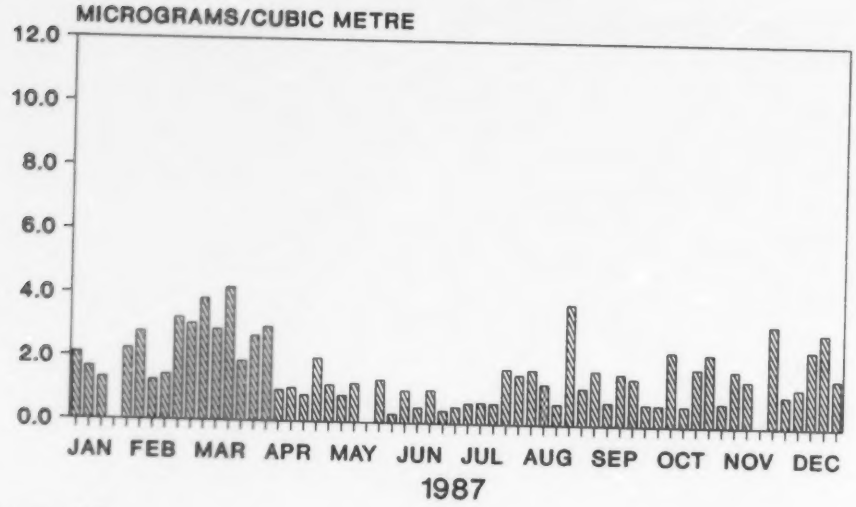


Figure 38

SULPHATE
ST. FRANCOIS-XAVIER #4304
24-Hour Samples

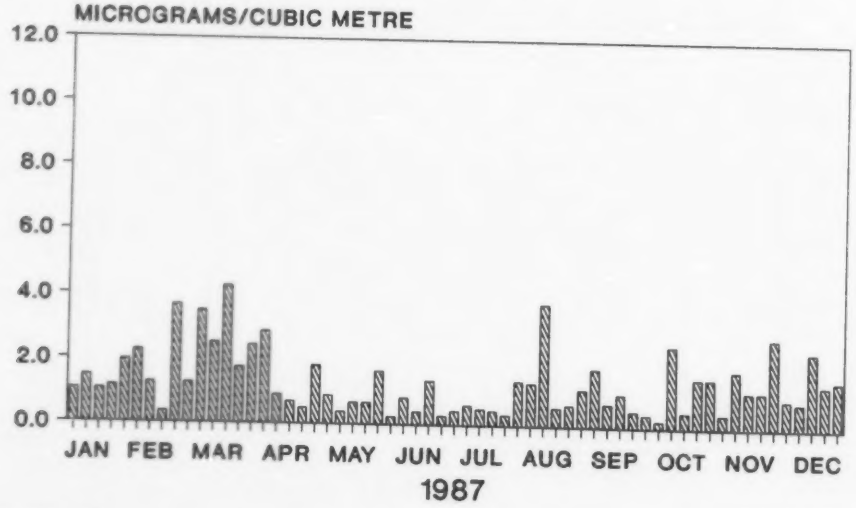


Figure 39

SULPHATE
BRANDON, 1104 PRINCESS #9201
24-Hour Samples

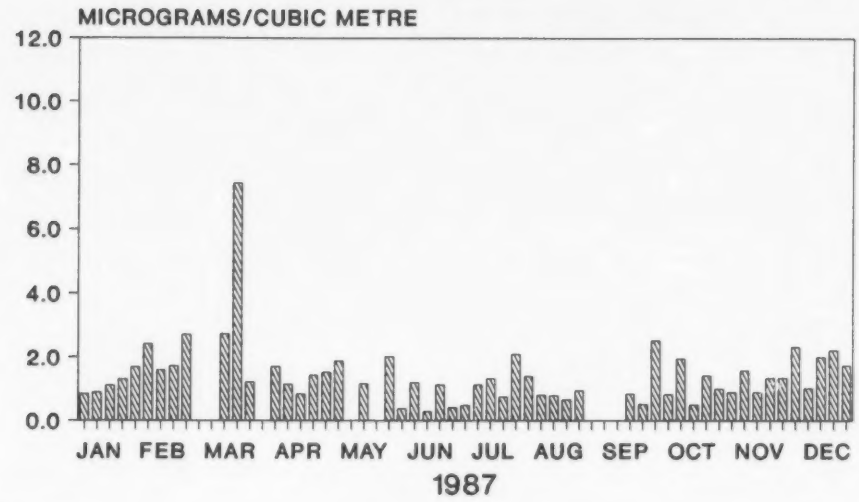


Figure 40

SULPHATE
BRANDON ASSN. COMM. COLLEGE #5131
24-Hour Samples

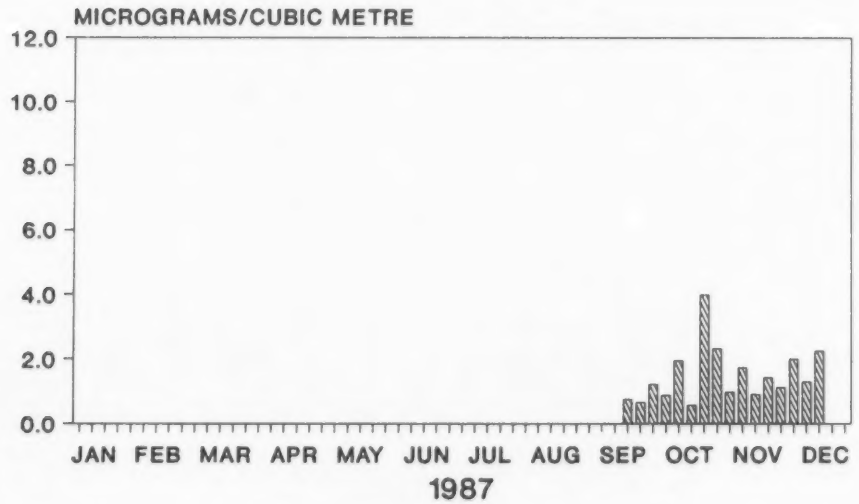


Figure 41

NITRATE
WINNIPEG, SCOTIA & JEFFERSON #9118
24-Hour Samples

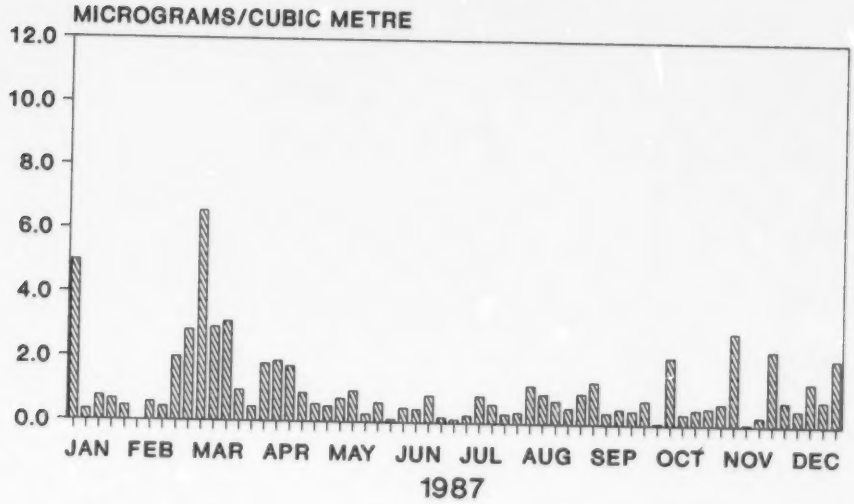


Figure 42

NITRATE
WINNIPEG, 65 ELLEN ST. #9119
24-Hour Samples

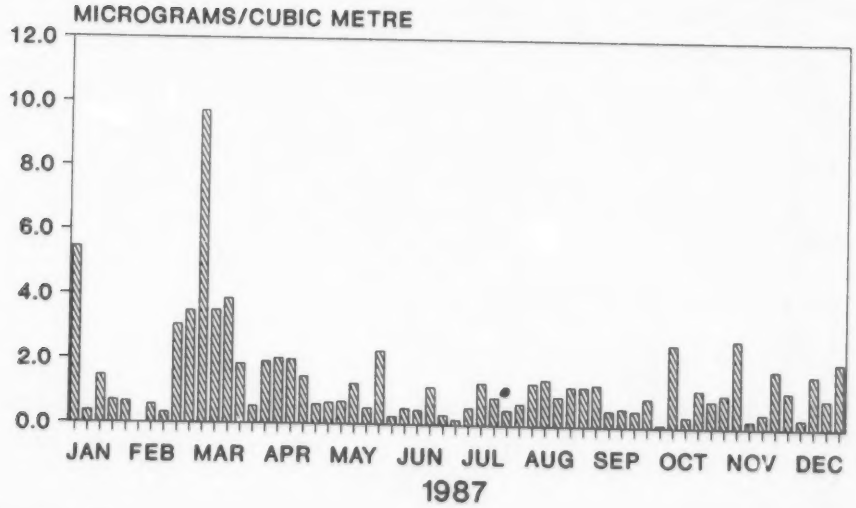


Figure 43

NITRATE
WINNIPEG, 2120 PORTAGE AVE. #9102
24-Hour Samples

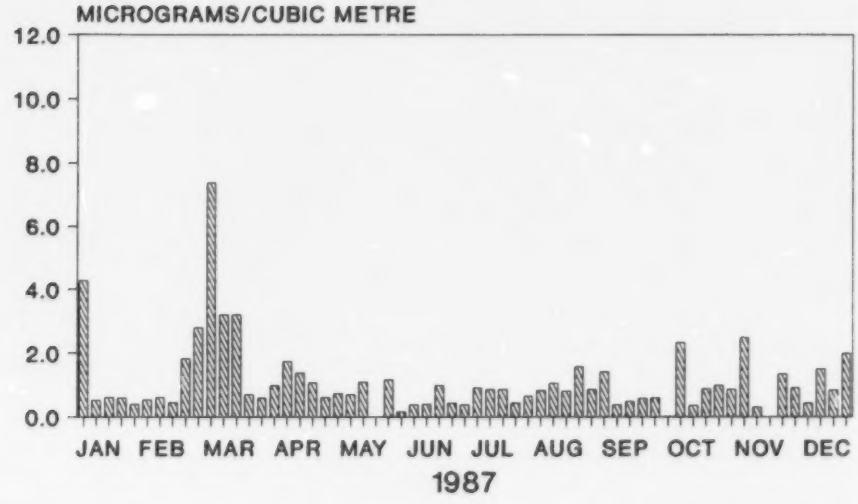


Figure 44

NITRATE
ST. FRANCOIS-XAVIER #4304
24-Hour Samples

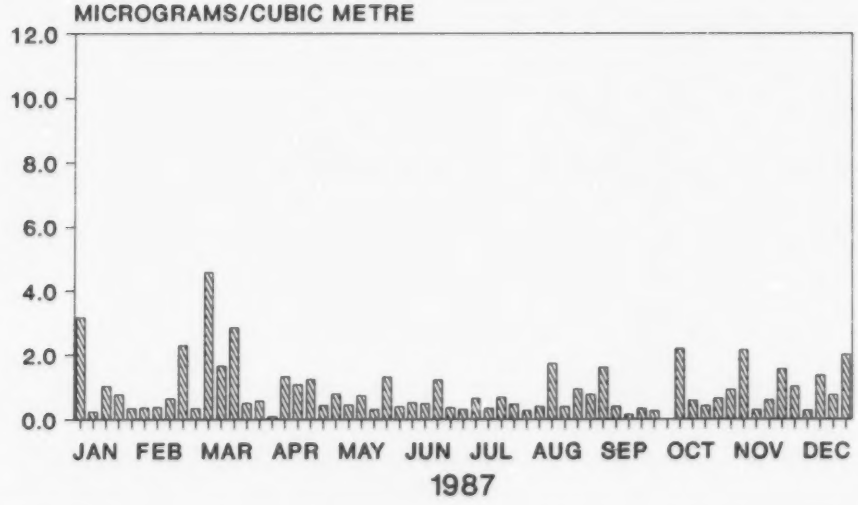


Figure 45

NITRATE
BRANDON, 1104 PRINCESS AVE. #9201
24-Hour Samples

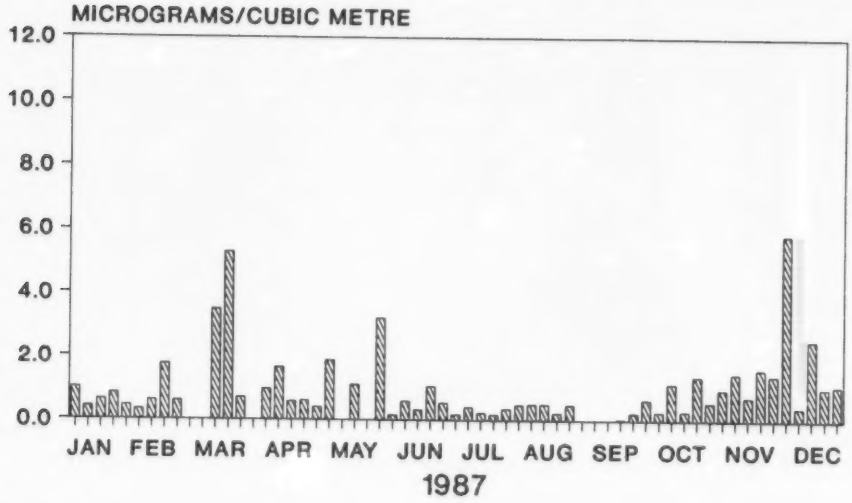


Figure 46

NITRATE
BRANDON ASSN. COMM. COLLEGE #5131
24-Hour Samples

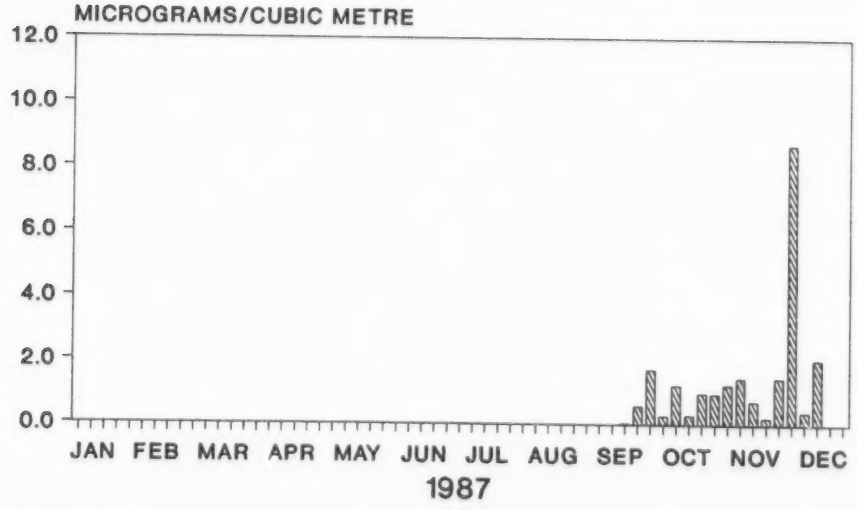
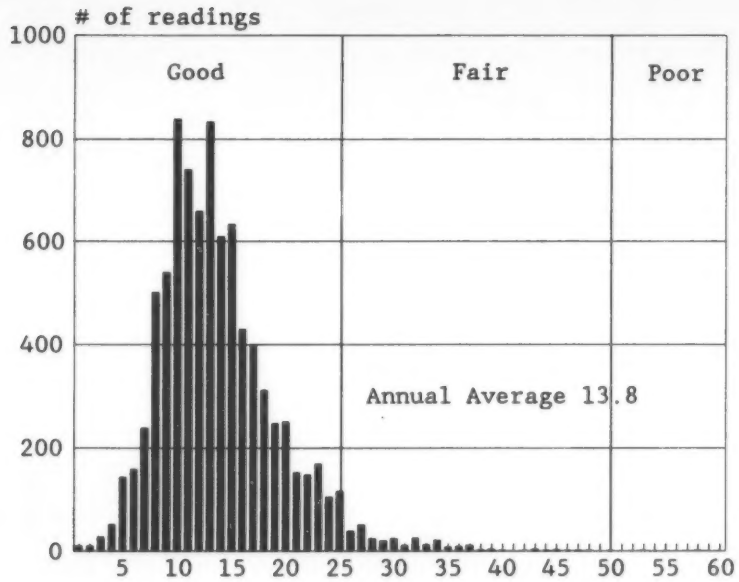


Figure 47

Air Quality Index

Winnipeg Downtown - 1987



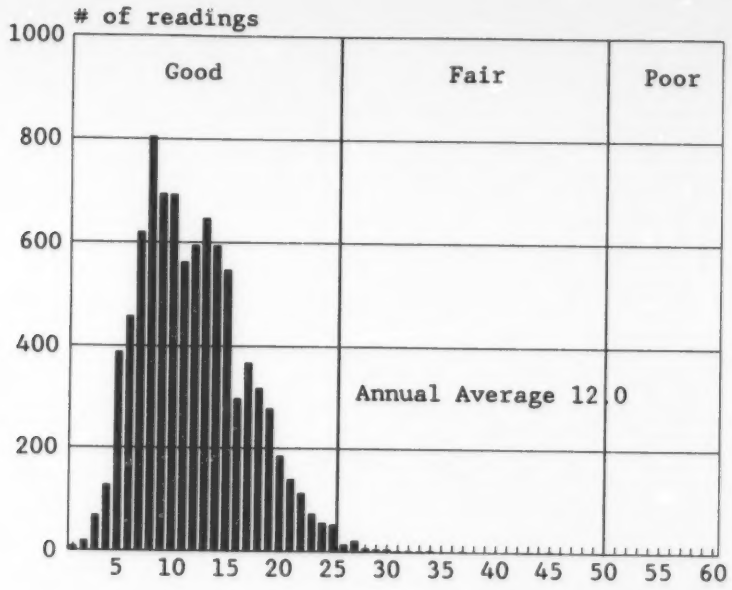
Downtown Winnipeg
Index of the Quality of Air - 1987 Annual
Distribution of Index Values by Influencing Contaminant

IQUA CLASS	Freq	CO	COH	NO2	O3	SO2
Severe (> 101)	0	--	--	--	--	--
Poor (51 - 100)	2 0.02%	0	2	0	0	0
Fair (26 - 50)	284 3.30%	0	127	0	157	0
Good (1 - 25)	8329 96.68%	202	2924	2340	2850	13
Overall	8615	202	3053	2340	3007	13
Unavailable	145					

Figure 48

Air Quality Index

Winnipeg Residential - 1987



Residential Winnipeg
Index of the Quality of Air - 1987 Annual
Distribution of Hourly Index Values by Influencing Contaminant

IQUA CLASS	Freq	CO	COH	NO2	O3	SO2
Severe (> 101)	0	--	--	--	--	--
Poor (51 - 100)	0	--	--	--	--	--
Fair (26 - 50)	66 0.75%	0	5	0	61	0
Good (1 - 25)	8694 99.25%	219	1875	1739	4855	6
Overall	8760	219	1880	1739	4916	6
Unavailable	0					

Figure 49